

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

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SEMICONDUCTOR TESTING DEVICE

of which the following is a specification : -

1        In the related art, various testing methods  
for testing a non-resin-sealed bare chip or a resin  
sealed semiconductor device having spherically  
projecting spherical connection terminals at the bottom  
5        surface thereof have been proposed and used.

Hereinafter, each of a non-resin-sealed bare chip and a  
resin-sealed semiconductor device will be generically  
referred to as a 'semiconductor device'.

When an electrical operational test of such a  
10      semiconductor device is performed, a probe of a testing  
device is placed in contact with the spherical  
connection terminals. Therefore, it is necessary that  
a test of electrical connection is performed in a  
condition in which deterioration of the spherical  
15      connection terminals is negligible. Further, the test  
should have high reliability at low cost.

One semiconductor testing method in the  
related art, for example, uses a semiconductor testing  
socket. When the semiconductor testing socket is used,  
20      an electrical operational test of a semiconductor  
device is performed using a probe. In this testing  
method, a testing substrate, on which a plurality of  
probes are arranged at positions corresponding to the  
positions of the plurality of spherical connection  
25      terminals formed on the bottom surface of the  
semiconductor device, is used. The projecting ends of  
these probes are caused to directly contact the  
spherical connection terminals, respectively, so as to  
perform the test.

30      This semiconductor testing socket has the  
plurality of probes arranged corresponding to the  
arrangement of the plurality of spherical connection  
terminals of the semiconductor device. Each probe has  
bent portion which is bent to a U-shape. When the  
35      probe is pressed onto a respective one of the spherical  
connection terminals of the semiconductor device, the  
bent portion of the probe is deformed, and thus,

1 possible damage to the spherical connection terminal is  
reduced.

5 However, when electrical testing of a  
semiconductor device is performed using the above-  
described probe testing method, the heights of the  
spherical connection terminals vary. Thereby, a case  
may occur where connection between the projecting end  
of the probe and the spherical connection terminal is  
not sufficient. As a result, the testing accuracy may  
10 be degraded.

15 Further, even though each probe has the U-  
shaped bent portion, when the projecting end of the  
probe contacts the spherical connection terminal, the  
spherical connection terminal, made of solder, may be  
deformed.

#### SUMMARY OF THE INVENTION

20 The present invention has been devised in  
consideration of the above-described problems. An  
object of the present invention is to provide a  
semiconductor testing device which can perform the test  
of a device having the spherical connection terminals,  
with high reliability, without deformation of the  
spherical terminals.

25 A semiconductor testing device, according to  
the present invention, for testing a semiconductor  
device which has at least one spherical connection  
terminal, comprises:

30 an insulating substrate having an opening  
formed therein at a position corresponding to the  
position of the spherical connection terminal; and  
35 a contact member, formed on the insulating  
substrate, comprising a connection portion which is  
connected with the spherical connection terminal, at  
least the connection portion being deformable and  
extending on the opening.

In this arrangement, even when the heights of

1 the spherical connection terminals vary, the variation  
of the heights of the spherical connection terminals  
can be accommodated as a result of the connection  
terminals being appropriately deformed. Thereby, it is  
5 possible that all the spherical connection terminals  
are positively connected with the contact members,  
respectively. Thus, the reliability of the test can be  
improved.

Further, during the deformation of the  
10 connection portions when the connection portions are  
connected with the spherical connection terminals,  
respectively, the spherical connection terminals slide  
on the connection portions. Thereby, even if oxide  
film and/or dust are present on the surfaces of the  
15 spherical connection terminals and the connection  
portions, the oxide film and/or dust are removed as a  
result of the sliding contact.

A semiconductor testing device, according to  
another aspect of the present invention, which device  
20 is used for performing a test on a semiconductor device  
having spherical connection terminals, comprises:

a contactor, provided with a single layer of  
insulating substrate, in which substrate an opening is  
formed at a position corresponding to a respective one  
25 of the spherical connection terminals, the contactor  
also being provided with a contact portion, which  
includes a connection portion with which the respective  
one of the spherical connection terminals is  
electrically connected, the contact portion being  
30 provided on the single layer of insulating substrate so  
that the connection portion is located on the opening;  
and

35 a wiring substrate, on which the contactor is  
mounted in a manner which permits installation and  
removal of the contactor onto and from the wiring  
substrate, the wiring substrate being provided with a  
first connection terminal which is provided on a first

1       surface, on which the contactor is mounted, and is  
      electrically connected with the contact portion, a  
      second connection terminal which is provided on a  
      second surface, which is opposite to the first surface,  
5       and is connected externally, and an interposer which  
      electrically connects the first connection terminal  
      with the second connection terminal.

10      In this arrangement, the contact portion and  
      the opening are provided at the position of the  
      insulating substrate facing the spherical connection  
      terminal, and the wiring substrate for passing an  
      electric signal from the semiconductor device  
      therethrough is provided below the insulating  
      substrate. Therefore, when the semiconductor device is  
15      loaded on the contactor, the spherical connection  
      terminal is connected with the contact portion, and is  
      electrically connected with the first connection  
      terminal provided on the wiring substrate via the  
      contact portion.

20      Further, the first connection terminal is  
      electrically connected with the second connection  
      terminal which acts as an external connection terminal  
      via the interposer. Therefore, by arbitrarily  
      arranging the interposer, it is possible to arbitrarily  
25      set a wiring path which electrically connects the first  
      connection terminal with the second connection  
      terminal.

30      Thus, the wiring path between the contact  
      portion and the second connection terminal is provided  
      not in the contactor but in the wiring substrate.  
      Thereby, it is not necessary to provide a multilayer  
      contactor, and a single-layer contactor can be used.  
      As a result, it is possible to reduce the cost of the  
      contactor. Thereby, when the contact portion is  
35      degraded as a result of a test being performed  
      repetitively, and, thereby, replacement of the  
      contactor is necessary, the replacement can be

1 performed at a low cost. Thus, it is possible to  
reduce the cost required for the maintenance.

5 The contact portion provided on the contactor  
causes the electric signal to flow therethrough from  
the semiconductor device to the wiring substrate below  
the insulating substrate directly. As a result, even  
when the pitch of the spherical connection terminals is  
reduced, it is possible to shorten the length of the  
wiring, and, also, it is possible to simplify the  
10 wiring arrangement. As a result, it is possible to use  
the semiconductor testing device in a high-speed  
electric test.

15 Other objects and further features of the  
present invention will become more apparent from the  
following detailed description when read in conjunction  
with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

20 FIGS.1 and 2 illustrate a semiconductor  
testing device in a first embodiment of the present  
invention;

FIG.3 shows a testing socket to which the  
semiconductor testing device in the first embodiment is  
applied;

25 FIGS.4 and 5 show wafer contactors to which  
the semiconductor testing device in the first  
embodiment is applied;

30 FIGS.6A and 6B illustrate a semiconductor  
testing device in a second embodiment of the present  
invention;

FIGS.7A and 7B illustrate a semiconductor  
testing device in a third embodiment of the present  
invention;

35 FIGS.8A and 8B illustrate a semiconductor  
testing device in a fourth embodiment of the present  
invention;

FIGS.9A and 9B illustrate a semiconductor

1 testing device in a fifth embodiment of the present  
inv ntion;

5 FIGS.10A and 10B illustrate a semiconductor  
testing device in a sixth embodiment of the present  
invention;

FIGS.11A and 11B illustrate a semiconductor  
testing device in a seventh embodiment of the present  
invention;

10 FIGS.12A and 12B illustrate a semiconductor  
testing device in an eighth embodiment of the present  
invention;

FIGS.13A and 13B illustrate a semiconductor  
testing device in a ninth embodiment of the present  
invention;

15 FIGS.14A and 14B illustrate a semiconductor  
testing device in a tenth embodiment of the present  
invention;

20 FIGS.15A and 15B illustrate a semiconductor  
testing device in an eleventh embodiment of the present  
invention;

FIGS.16A and 16B illustrate a semiconductor  
testing device in a twelfth embodiment of the present  
invention;

25 FIG.17 illustrates a semiconductor testing  
device in a thirteenth embodiment of the present  
invention;

FIG.18 illustrates a semiconductor testing  
device in a fourteenth embodiment of the present  
invention;

30 FIG.19 illustrates a semiconductor testing  
device in a fifteenth embodiment of the present  
invention;

FIG.20 illustrates a semiconductor testing  
device in a sixteenth embodiment of the present  
invention;

35 FIG.21 illustrates a semiconductor testing  
device in a seventeenth embodiment of the present

1 inv ntion;

FIGS.22A and 22B illustrate a semiconductor testing device in a eighteenth embodiment of the present invention;

5 FIG.23 illustrates a semiconductor testing device in a nineteenth embodiment of the present invention;

10 FIG.24 illustrates a semiconductor testing device in a twentieth embodiment of the present invention;

FIG.25 illustrates a testing socket in a twenty-first embodiment of the present invention;

15 FIG.26 illustrates a semiconductor testing device in a twenty-second embodiment of the present invention;

FIGS. 27A, 27B and 28 show elevational sectional views for illustrating a semiconductor testing device in a twenty-third embodiment of the present invention;

20 FIGS. 29A and 29B illustrate one example of a semiconductor testing device;

FIG. 30 illustrates another example of a semiconductor testing device;

25 FIG. 31 illustrates another example of a semiconductor testing device;

FIG. 32 shows an elevational sectional view for illustrating a semiconductor testing device in a twenty-fourth embodiment of the present invention;

30 FIG. 33A shows an elevational sectional view for illustrating a semiconductor testing device in a twenty-fifth embodiment of the present invention; and FIG. 33B shows a partially magnified plan view of an insulating substrate of the semiconductor testing device in the twenty-fifth embodiment of the present invention;

35 FIG. 34 shows an elevational sectional view for illustrating a semiconductor testing device in a

- 1        twenty-sixth embodiment of the present invention;  
FIG. 35 shows an elevational sectional view  
for illustrating a semiconductor testing device in a  
twenty-seventh embodiment of the present invention;
- 5        FIG. 36 shows an elevational sectional view  
for illustrating a semiconductor testing device in a  
twenty-eighth embodiment of the present invention;  
FIGS. 37A and 37B illustrate first and second  
variant examples of contact portions, respectively;
- 10      FIGS. 38A and 38B illustrate a third variant  
example of a contact portion;  
FIGS. 39A and 39B illustrate a fourth variant  
example of a contact portion;
- 15      FIGS. 40A and 40B illustrate a fifth variant  
example of a contact portion;  
FIGS. 41A and 41B illustrate a sixth variant  
example of a contact portion;
- 20      FIGS. 42A and 42B illustrate a seventh  
variant example of a contact portion;  
FIGS. 43A and 43B illustrate an eighth  
variant example of a contact portion;
- 25      FIGS. 44A and 44B illustrate a ninth variant  
example of a contact portion;  
FIGS. 45A and 45B illustrate a tenth variant  
example of a contact portion;
- 30      FIGS. 46A and 46B illustrate an eleventh  
variant example of a contact portion;  
FIGS. 47A and 47B illustrate a twelfth  
variant example of a contact portion;
- 35      FIG. 48 illustrates a thirteenth variant  
example of a contact portion;  
FIG. 49 shows an elevational sectional view  
for illustrating a semiconductor testing device in a  
twenty-ninth embodiment of the present invention;  
FIG. 50 shows an elevational sectional view  
for illustrating a semiconductor testing device in a  
thirtieth embodiment of the present invention;

1 FIG. 51 shows an elevational sectional view  
for illustrating a semiconductor testing device in a  
thirty-first embodiment of the present invention;

5 FIG. 52 shows a plan view for illustrating a  
semiconductor testing device in a thirty-second  
embodiment of the present invention; and

FIGS. 53A and 53B show elevational sectional  
views for illustrating a semiconductor testing device  
in a thirty-third embodiment of the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

U.S. patent application Serial No.

09/009,261, filed on January 20, 1998, is incorporated  
herein by reference.

15 Embodiments of the present invention will be  
described with reference to figures.

FIGS. 1 and 2 illustrate a semiconductor  
testing device 10A in a first embodiment of the present  
invention. FIG. 1 shows a side sectional elevation view  
20 of part of the semiconductor testing device 10A. FIG. 2  
shows a bottom view of part of the semiconductor  
testing device 10A. Generally, the semiconductor  
testing device 10A in the first embodiment has an  
insulating substrate 14 and contact members 18.

25 As shown in FIG. 1, a semiconductor device 1  
is loaded on the semiconductor testing device 10A. In  
this loaded state, the semiconductor testing device 10A  
performs an electrical operational test of the  
semiconductor device 1. The devices on which the  
30 semiconductor testing device 10A performs the test are  
semiconductor devices such as the semiconductor device  
1 which has the spherical connection terminal 2  
(hereinafter, referred to as a 'bump').

35 In the following descriptions, examples using  
the semiconductor device 1 having the bump 2 will be  
mainly described. However, semiconductor testing  
devices in respective embodiments which will be

1 described now can be applied to various devices (for example, a bare chip, a wafer, and so forth).

The semiconductor testing device 10A will now be described in detail.

5 The insulating substrate 14 is a film member made of an insulating resin material such as a polyimide or the like. The insulating substrate 14 is slightly flexible. A plurality of openings 16 are formed in the insulating substrate 14. The positions 10 of the openings 16 correspond to the positions of the bumps 2 formed on the semiconductor device 1, respectively.

Accordingly, in a condition where the semiconductor device 1 is correctly positioned over the insulating substrate 14, each bump 2 of the semiconductor device 1 faces a respective one of the openings 16 of the insulating substrate 14. Further, the diameter of each opening 16 is set to be slightly larger than the diameter of each bump 2. Accordingly, 20 when the semiconductor device 1 is loaded on the semiconductor testing device 10A, the openings 16 function as guiding holes for the bumps 2.

Each contact member 18 is made of, for example, a copper (Cu) film, and is formed to have a predetermined pattern using a thin-film forming technique such as a plating method, an evaporation method, an etching method, a photolithography technique or the like. Each contact member 18 includes an integrally formed wiring portion 20, a terminal portion 30 22, a connection portion 24A and so forth.

The terminal portion 22 is, for example, a portion with which a connection pin 42, shown in FIG.3, is connected. Each connection pin 42 connects a testing board 40 and the semiconductor testing device 35 10A with one another. Normally, each terminal portion 22 is located in proximity to an edge of the insulating substrate 14. The connection portions 24A are portions

1 which are electrically connected with the bumps 2 of  
the semiconductor device 1. Therefor, the connection  
portions 24A are provided at the positions which  
correspond to the positions of the bumps 2 of the  
5 semiconductor device 1, respectively. Each of the  
wiring portions 20 connects a respective one of the  
terminal portions 22 and a respective one of the  
connection portions 24A with one another.

The outline shape of each connection portion  
10 24A is approximately circular and corresponds to the  
shape of each bump 2. An opening 26A is formed in each  
connection portion 24A at the center thereof. In the  
first embodiment, the shape of the opening 26A is a  
cross. Because the positions of the connection  
15 portions 24A correspond to the positions of the bumps,  
as mentioned above, the positions of the openings 16  
formed in the insulating substrate 14 correspond to the  
positions of the connection portions 24A, respectively.

That is, the insulating substrate 14 is not  
20 present at the position of each connection portion 24A,  
and thus, each connection portion 24A is exposed  
through a respective one of the openings 16.  
Accordingly, when the semiconductor device 1 is loaded  
25 on the semiconductor testing device 10A, the bumps 2  
are electrically connected with the connection portions  
24A through the openings 16, respectively, as shown in  
FIG.1.

As mentioned above, the insulating substrate  
14 is not present at the position of each connection  
30 portion 24A, and the opening 26A is formed in each  
connection portion 24A at the center thereof.  
Accordingly, as a result of the connection portions 24A  
being pressed by the bumps 2, each connection portion  
24A is easily deformed.

35 A method for performing a test on the  
semiconductor device 1 using the semiconductor testing  
device 10A will now be described.

1       First, the semiconductor device 1 is  
positioned with respect to the semiconductor testing  
device 10A so that the bumps 2 of the semiconductor  
device 1 are aligned with the connection portions  
5       (openings 16) of the semiconductor testing device 10A.  
Then, as a result of pressing the semiconductor device  
1 onto the semiconductor testing device 10A, the bumps  
2 are connected with the connection portions 24A.  
Thus, the semiconductor device 1 is loaded on the  
10      semiconductor testing device 10A. A semiconductor  
tester (not shown in the figures) is connected with the  
semiconductor testing device 10A. In the state in  
which the semiconductor device 1 is loaded on the  
semiconductor testing device 10A, an electrical  
15      operational test is performed on the semiconductor  
device 1 through the semiconductor tester.

Thus, the work of loading the semiconductor  
device 1 on the semiconductor testing device 10A is  
very simple and easily performed.

20      Further, as mentioned above, each connection  
portion 24A with which a respective one of the bumps 2  
is connected is deformable. Accordingly, even if the  
sizes (heights) of the bumps 2 vary, as a result of the  
connection portions 24A being deformed, the variation  
25      of the heights of the bumps 2 is accommodated, and  
thus, it is possible that all the bumps 2 are  
positively connected with the connection portions 24A  
(contact members 18), respectively. Thus, the  
reliability of the test can be improved.

30      Further, as shown in FIG.1, each connection  
portion 24A is deformed when the connection portions  
24A are connected with the bumps 2, respectively.  
During the deformation of the connection portions 24A,  
the bumps 2 slide on the connection portions 24A.  
35      Thereby, even if an oxide film and/or dust are present  
on the surfaces of the bumps 2 and the connection  
portions 24A, the oxide film and/or dust are removed as

1 a result of the sliding contact. Such an effect is  
call d a wiping effect.

5 Thereby, it is possible to make the surfaces  
of the bumps 2 and the connection portions 24A clean  
10 when the semiconductor device 1 is loaded on the  
semiconductor testing device 10A. As a result, it is  
possible to improve the test accuracy. Further, when  
the semiconductor device 1 is mounted on a circuit  
substrate after the test, the reliability of the  
15 electrical connection between the semiconductor device  
1 and the circuit substrate can be improved.

Further, as shown in FIG.1, each connection  
portion 24A is deformed along the outer surface of a  
respective one of the bumps 2 when the semiconductor  
15 device 1 is loaded on the semiconductor testing device  
10A. Thereby, the contact area between the connection  
portion 24A and the bump 2 increases. Thus, it is  
possible to ensure the electrical connection  
therebetween. The above-mentioned effects/advantages  
20 provided in the first embodiment are similarly provided  
in each of the other embodiments described later.

FIG.3 shows an arrangement in which the  
semiconductor testing device 10A is applied to a  
testing socket 30A which is used when the semiconductor  
25 device 1 is tested. The semiconductor testing device  
10A is set in a body portion 32 of the testing socket  
30A. A lid portion 34 is rotatably supported on the  
body portion 32 by a shaft 36. This lid portion 34 is  
locked in a closed position by a locking pin 38. FIG.3  
30 shows the condition in which the lid portion 34 is  
locked in the closed position.

35 In this locked condition, the lid portion 34  
presses the semiconductor device 1 onto the  
semiconductor testing device 10A. Thereby, as  
described above, the bumps 2 formed on the  
semiconductor device 1 are connected with the  
connection portions 24A formed on the semiconductor

1 testing device 10A. The semiconductor testing device  
10A is connected with the testing board 40 through the  
terminal portions 22 and the connection pins 42. In  
this condition, a predetermined test can be performed  
5 on the semiconductor device 1 through the testing board  
40.

The semiconductor testing device 10A in the  
first embodiment can be applied not only to the test of  
the semiconductor device 1 using the arrangement shown  
10 in FIG.3 but also to wafer contactors 44A and 44B shown  
in FIGS.4 and 5, respectively.

These wafer contactors 44A and 44B are used  
when a test is performed on a wafer 3 on which a  
predetermined electronic circuit is formed and then  
15 bumps 2 are formed. Each of the wafer contactors 44A  
and 44B includes a wafer holder 46 for holding the  
wafer 3 and a base 48.

The wafer 3 is set in the wafer holder 46 in  
a position in which the bumps 2 of the wafer 3 project  
20 upward, and then, the semiconductor testing device 10A  
is loaded on the wafer 3. Then, the base 48 is placed  
on the semiconductor testing device 10A. Hooks 47,  
projecting downwardly from the base 48, pass through  
through holes formed in the wafer holder 46, and the  
25 projecting ends of the hooks 47 engage with the bottom  
surface of the wafer holder 46. Thus, the base 48 is  
locked with the wafer holder 46. Thereby, the base 48  
presses the semiconductor testing device 10A onto the  
wafer 3. When the locking of the base 48 with the  
30 wafer holder 46 is released, each of the hooks 47 is  
laterally bent and thereby, the engagement between the  
bottom surface of the wafer holder 46 and the  
projecting end of the hook 47 is released.

Because the base 48 is smaller than the wafer  
35 holder 46, the terminal portions 22 of the  
semiconductor testing device 10A are externally  
exposed. In the wafer contactor 44A shown in FIG.4,

1 contacts 50 are electrically connected with the exposed  
2 terminal portions 22, respectively. In the wafer  
3 contactor 44B shown in FIG.5, connector 52 is  
4 electrically connected with the exposed terminal  
5 portions 22. In this condition, a test is performed on  
6 the wafer 3. Thus, the semiconductor testing device  
7 10A can also be applied to the test of the wafer 3 in  
8 the arrangements shown in FIG.4 and FIG.5. In each of  
9 the arrangements shown in FIGS.4 and 5, advantages  
10 similar to those described above can be provided. This  
can also be said for the other embodiments described  
later.

A second embodiment of the present invention  
will now be described.

15 FIGS.6A and 6B show a semiconductor testing  
device 10B in the second embodiment of the present  
invention. FIG.6A shows a side sectional elevation  
view of part of the semiconductor testing device 10B.  
FIG.6B shows a bottom view of part of the semiconductor  
20 testing device 10B. In FIGS.6A and 6B, for the  
components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
descriptions thereof will be omitted. Hereinafter,  
25 although each semiconductor testing device has a  
plurality of contact members 18, descriptions will be  
made mainly for only one contact member 18 for the sake  
of simplification of descriptions.

30 In the semiconductor testing device 10B in  
the second embodiment, a connection portion 24B extends  
from only one side of the opening 16 so as to have a  
cantilever-like shape. Further, a roughened surface 25  
is formed at least at an area of the connection portion  
24B, at which area the connection portion 24B is  
35 connected with the bump 2.

As a result of the connection portion 24B  
having the cantilever-like shape, possible deformation

1 of the connection portion 24B can be increased.  
Thereby, even if the variation in the heights of the  
bumps 2 is large, this can be easily accommodated.  
Thereby, a highly reliable test can be performed.  
5 Further, because the possible deformation of the  
connection portion 24B is large, the contact area  
between the connection portion 24B and the bump 2  
increases. Thus, it is possible to ensure the  
electrical connection therebetween.  
10 Further, also by forming the roughened  
surface 25 at least at the area at which the connection  
portion 24 is connected with the bump 2, it is possible  
to ensure the electrical connection therebetween. The  
roughened surface 25 has minute unevenness thereon, and  
15 thus, the effective surface area is large. When the  
bump 2 comes into contact with the connection portion  
24B, the minute projections of the roughened surface  
protrude into the bump 2. Thereby, electrical  
connection between the connection portion 24B and the  
20 bump 2 can be ensured.

The roughened surface 25 is formed by, for  
example, a method of treating the surface of the  
connection portion 24B with chemicals, by blasting or  
the like.

25 A third embodiment of the present invention  
will now be described.

FIGS.7A and 7B show a semiconductor testing  
device 10C in the third embodiment of the present  
invention. FIG.7A shows a side sectional elevation  
30 view of part of the semiconductor testing device 10C.  
FIG.7B shows a bottom view of part of the semiconductor  
testing device 10C. Also in FIGS.7A and 7B, for the  
components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
35 the same reference numerals are given and the  
descriptions thereof will be omitted.

In the semiconductor testing device 10C in

1 the third embodiment, a connection portion 24C includes  
one pair of cantilever portions 56. Specifically, the  
connection portion 24C includes a ring portion 54, and,  
as shown in FIG.7B, the pair of cantilever portions 56  
5 extend from opposite sides of the ring portion 54  
toward the center of the ring portion.

The possible amount of deformation of the  
cantilever portions 56, when the semiconductor device 1  
is loaded on the semiconductor testing device 10C and  
10 the bump 2 presses the cantilever portions 56, is  
larger than the case of the connection portion 24A in  
the first embodiment, and is smaller than the case of  
the connection portion 24B in the second embodiment.  
Accordingly, when the heights of the bumps 2 vary, one  
15 of the first, second and third embodiments may be  
appropriately selected.

Further, in the third embodiment, since the  
cantilever portions 56 come into contact with the bump  
2 on two sides as shown in FIG.7A, it is possible to  
20 hold the bump 2 more stably in comparison to the case  
of the second embodiment. Further, in comparison to  
the first embodiment, the mechanical strength of the  
connection portion 24C can be increased, and thus,  
occurrence of plastic deformation of the connection  
25 portion 24C can be prevented.

A fourth embodiment of the present invention  
will now be described.

FIGS.8A and 8B show a semiconductor testing  
device 10D in the fourth embodiment of the present  
30 invention. FIG.8A shows a side sectional elevation  
view of part of the semiconductor testing device 10D.  
FIG.8B shows a bottom view of part of the semiconductor  
testing device 10D. Also in FIGS.8A and 8B, for the  
components/parts identical to those of the  
35 semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
descriptions thereof will be omitted.

1        In the second embodiment, the connection portion 24B has a flat-plate cantilever shape. In contrast to this, in the semiconductor testing device 10D in the fourth embodiment, a connection portion 24D  
5        is a forked cantilever portion 58. In comparison to the connection portion 24B in the second embodiment, the connection portion 24D is more likely to be deformed. Thereby, the variation of the heights of the bumps 2 can be effectively accommodated.

10      However, because the connection portion 24D is likely to be deformed, in a case where the contact member 18 is made of copper (Cu), plastic deformation of the connection portion 24D is likely to occur. Accordingly, in the fourth embodiment, it is preferable  
15      that the contact portion 18 (including the connection portion 24D) is made of a material which has elasticity and also high electric conductivity.

A fifth embodiment of the present invention will now be described.

20      FIGS.9A and 9B show a semiconductor testing device 10E in the fifth embodiment of the present invention. FIG.9A shows a side sectional elevation view of part of the semiconductor testing device 10E. FIG.9B shows a bottom view of part of the semiconductor testing device 10E. Also in FIGS.9A and 9B, for the components/parts identical to those of the semiconductor testing device 10A shown in FIGS.1 and 2, the same reference numerals are given and the descriptions thereof will be omitted.

30      In the semiconductor testing device 10B-10D in the second through fourth embodiments, each of the connection portions 24B-24D has a cantilever shape. In contrast to this, in the semiconductor testing device 10E in the fifth embodiment, a connection portion 24E includes a portion 60 supported on both ends. Each of the both ends of the portion 60 is integrally connected with a ring portion 54.

1 By using the portion 60 supported on both  
ends, the mechanical strength of the connection portion  
20E can be increased. Thereby, the connection portion  
20E can be prevented from being degraded due to long-  
5 term use.

A sixth embodiment of the present invention  
will now be described.

FIGS.10A and 10B show a semiconductor testing  
device 10F in the sixth embodiment of the present  
10 invention. FIG.10A shows a side sectional elevation  
view of part of the semiconductor testing device 10F.  
FIG.10B shows a bottom view of part of the  
semiconductor testing device 10F. Also in FIGS.10A and  
15 10B, for the components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
descriptions thereof will be omitted.

In the sixth embodiment, a connection portion  
24F is obtained as a result of forming an opening 63 at  
20 the center line of the portion 60 of the connection  
portion 24E in the fifth embodiment. Thus, a pair of  
portions 62, each supported at both ends, are formed.

By forming the pair of portions 62 in the  
connection portion 24F, the amount of deformation of  
25 the portions 62 can be increased. Thereby, variation  
in the heights of the bumps 2 can be effectively  
accommodated.

Further, by providing the opening 63 between  
the portions 62, the bottom-end portion of the bump 2  
30 is located in the opening 63. Thereby, movement of the  
bump 2 on the connection portion 24F can be prevented.  
Accordingly, the semiconductor device 1 can be  
positively positioned on the semiconductor testing  
device 10F.

35 A seventh embodiment of the present invention  
will now be described.

FIGS.11A and 11B show a semiconductor testing

1 device 10G in the seventh embodiment of the present  
invention. FIG.11A shows a side sectional elevation  
view of part of the semiconductor testing device 10G.  
FIG.11B shows a bottom view of part of the  
5 semiconductor testing device 10G. Also in FIGS.11A and  
11B, for the components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
descriptions thereof will be omitted.

10 In the above-described first embodiment, the  
cross-shaped opening 26A is formed at the center of the  
connection portion 24A so that the connection portion  
24A is deformable. In contrast to this, in the seventh  
embodiment, a straight-line slit 26B is formed in a  
15 connection portion 24G of the semiconductor testing  
device 10G so that the connection portion 24G is  
deformable.

20 The possible amount of deformation of the  
connection portion 24G in the seventh embodiment is  
less than the possible amount of deformation of the  
connection portion 24A in the first embodiment.  
However, the mechanical strength of the connection  
portion 24G is higher than that of the connection  
portion 24A. Accordingly, in accordance with the  
25 material of the bump 2 (for example, whether the bump 2  
is made of solder or gold, and so forth), an  
appropriate one of the slits 26A and 26B may be  
selected.

30 In the seventh embodiment, the connection  
portion can be easily deformed. As a result, the  
variation of the heights of the bumps can be  
accommodated as a result of the connection portion  
being appropriately deformed. Further, because the  
contact area between the connection portion and the  
35 bump is increased, a positive electrical connection can  
be provided.

An eighth embodiment of the present invention

1 will now be described.

FIGS.12A and 12B show a semiconductor testing device 10H in the eighth embodiment of the present invention. FIG.12A shows a side sectional elevation 5 view of part of the semiconductor testing device 10H. FIG.12B shows a bottom view of part of the semiconductor testing device 10H. Also in FIGS.12A and 12B, for the components/parts identical to those of the semiconductor testing device 10A shown in FIGS.1 and 2, 10 the same reference numerals are given and the descriptions thereof will be omitted.

In the eighth embodiment, a circular opening 26C is formed at the center of a connection portion 24H. The possible amount of deformation of the 15 connection portion 24H is less than that of the connection portion 24G in the seventh embodiment, while the mechanical strength of the connection portion 24H is higher than the connection portion 24G.

Accordingly, as mentioned above, an appropriate one of 20 the slits 26A, 26B and the opening 26C may be selected. Further, in the eighth embodiment, because the opening 26C is located at the center of the connection portion 24H and also has a circular shape, the bump 2 is always located at the center of the connection portion 24H.

25 Accordingly, the semiconductor device 1 can be positively positioned on the semiconductor testing device 10H.

In the eighth embodiment, the connection portion can be easily deformed. As a result, the 30 variation of the heights of the bumps can be accommodated as a result of the connection portion being appropriately deformed. Further, because the contact area between the connection portion and the bump is increased, a positive electrical connection can 35 be provided.

A ninth embodiment of the present invention will now be described.

1 FIGS.13A and 13B show a semiconductor testing  
d vice 10I in the ninth embodiment of th present  
invention. FIG.13A shows a side sectional elevation  
view of part of the semiconductor testing device 10I.  
5 FIG.13B shows a bottom view of part of the  
semiconductor testing device 10I. Also in FIGS.13A and  
13B, for the components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
10 descriptions thereof will be omitted.

In the ninth embodiment, many small-diameter  
circular openings 26D are formed in a connection  
portion 24I. By forming a large number of circular  
openings 26D in the connection portion 24I, similar to  
15 the above-described embodiments, the connection portion  
24I is deformable. The possible amount of deformation  
can be adjusted by appropriately selecting the number  
of the circular openings 26D and the diameter of each  
circular opening 26D.

20 Further, by forming the large number of  
circular openings 26D, when the bump 2 is pressed onto  
the connection portion 24I, the edge of each circular  
opening 26D cuts into the bump 2. Therefore, the  
connection portion 24I provides an effect the same as  
25 that provided by the roughened surface 25 of the second  
embodiment. Thereby, electrical connection between the  
connection portion 24I and the bump 2 can be ensured.

In the ninth embodiment, the connection  
portion can be easily deformed. As a result, the  
30 variation of the heights of the bumps can be  
accommodated as a result of the connection portion  
being appropriately deformed. Further, because the  
contact area between the connection portion and the  
bump is increased, a positive electrical connection can  
35 be provided.

A tenth embodiment of the present invention  
will now be described.

1 FIGS.14A and 14B show a semiconductor testing  
device 10J in the tenth embodiment of the present  
invention. FIG.14A shows a side sectional elevation  
view of part of the semiconductor testing device 10J.  
5 FIG.14B shows a bottom view of part of the  
semiconductor testing device 10J. Also in FIGS.14A and  
14B, for the components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
10 descriptions thereof will be omitted.

In each of the above-described embodiments,  
the connection portion is integrally formed in the  
contact member 18. In contrast to this, in the tenth  
embodiment, a direct-contact part 64 of a connection  
15 portion 24J is a member different from the other  
portion of the contact member 18.

By using the different member as the direct-  
contact part 64 of the connection portion 24J, it is  
possible to separately select the material of the  
20 contact member 18 and the material of the direct-  
contact part 64. Accordingly, it is possible to select  
a material that is optimum for the function of the  
contact member 18 and to select a material that is  
optimum for the function of the direct-contact part 64.

25 In the semiconductor testing device 10J in  
the tenth embodiment, in order to set the possible  
amount of deformation of the direct-contact part 64 of  
the connection portion 24J to be large, the direct-  
contact part 64 is a foil-like terminal. In the tenth  
30 embodiment, the foil-like terminal 64 (direct-contact  
part) is made of aluminum (Al), and the other portion  
of the contact member 18 is made of copper (Cu).

An eleventh embodiment of the present  
invention will now be described.

35 FIGS.15A and 15B show a semiconductor testing  
device 10K in the eleventh embodiment of the present  
invention. FIG.15A shows a side sectional elevation

1 view of part of the semiconductor testing device 10K.  
FIG.15B shows a bottom view of part of the  
semiconductor testing device 10K. Also in FIGS.15A and  
5 15B, for the components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
descriptions thereof will be omitted.

In the eleventh embodiment, similar to the  
tenth embodiment, a connection portion 24K is a member  
10 different from the other portion of the contact member  
18. The connection portion 24K is a direct-contact  
part which is a cantilever-shaped wire 66.

15 The cantilever-shaped wire 66 is formed using  
the wire-bonding technique. Specifically, wire bonding  
is performed at a position on the contact member 18 in  
proximity to the opening 16 using a wire-bonding  
apparatus. Then, after a predetermined length of wire  
is pulled out, the wire is cut. As a result, the wire  
is in a condition indicated by the broken line in  
20 FIG.15A.

25 Then, the wire is bent to the side of the  
opening 16. Thus, the cantilever-shaped wire 66 is  
formed (indicated by the solid line in FIG.15A). By  
forming the connection portion 24K using the wire-  
bonding technique, the connection portion 24K is easily  
and efficiently formed, and also, the cost can be  
reduced.

30 Further, in the eleventh embodiment, the  
connection portion 24K is the cantilever-shaped wire  
66, one end of the wire 66 being fixed and the other  
end of the wire 66 being free. Thereby, the possible  
amount of deformation of the cantilever-shaped wire 66  
is relatively large. As a result, even if the  
variation of the heights of the bumps 2 is large, the  
35 variation can be accommodated.

A twelfth embodiment of the present invention  
will now be described.

1 FIGS.16A and 16B show a semiconductor testing  
devic 10L in the twelfth embodiment of the present  
invention. FIG.16A shows a side sectional elevation  
view of part of the semiconductor testing device 10L.  
5 FIG.16B shows a bottom view of part of the  
semiconductor testing device 10L. Also in FIGS.16A and  
16B, for the components/parts identical to those of the  
semiconductor testing device 10A shown in FIGS.1 and 2,  
the same reference numerals are given and the  
10 descriptions thereof will be omitted.

Also in the twelfth embodiment, similar to  
the above-described eleventh embodiment, a direct-  
contact part 68 of the connection portion 24L is a  
wire. Although the connection portion 24K is the  
15 cantilever-shaped wire 66 in the eleventh embodiment,  
the direct-contact part 68 of the connection portion  
24L is a wire supported at both ends in the twelfth  
embodiment.

The wire 66 supported at both ends is formed  
20 also using the wire-bonding technique. Specifically,  
first bonding is performed at a position on a frame  
portion 54 of the connection portion 24L in proximity  
to the opening 16. Then, after the wire is pulled out  
a predetermined length, second bonding is performed at  
25 a position on the frame portion 54 opposite to the  
position of the first bonding. Thereby, each of the  
both ends of the wire 68 is fixed to the frame portion  
54. The mechanical strength of the connection portion  
24L in the twelfth embodiment is higher than that of  
30 the connection portion 24L in the eleventh embodiment.

A thirteenth embodiment of the present  
invention will now be described.

FIG.17 shows a bottom view of part of a  
semiconductor testing device 10M in th thirteenth  
35 embodiment of th present invention. Also in FIG.17,  
for the components/parts identical to those of the  
semiconductor t sting device 10A shown in FIGS.1 and 2,

1 the same reference numerals are given and the  
descriptions thereof will b omitted.

5 In the connection portion 24M of the  
semiconductor testing device 10M, two of the wires 68,  
each supported at both ends, as described above for the  
twelfth embodiment, are used. The two wires 68 are  
arranged so as to form a cross as shown in FIG.17. In  
this arrangement in the thirteenth embodiment, the  
effect provided by the twelfth embodiment can also be  
10 provided, and also, in comparison to the arrangements  
of the eleventh and twelfth embodiments shown in  
FIGS.15A, 15B, 16A and 16B, movement of the bump 2 can  
be prevented. Thereby, the semiconductor device 1 can  
be positively positioned on the semiconductor testing  
15 device 10M.

A fourteenth embodiment of the present  
invention will now be described.

20 FIG.18 shows part of a semiconductor testing  
device 10N in the fourteenth embodiment of the present  
invention. Also in FIG.18, for the components/parts  
identical to those of the semiconductor testing device  
10A shown in FIGS.1 and 2, the same reference numerals  
are given and the descriptions thereof will be omitted.

25 In the above-described respective  
embodiments, basically, each of the semiconductor  
testing devices 10A-10M includes the insulating  
substrate 14 and the contact member 18. In contrast to  
this, in the semiconductor testing device 10N in the  
fourteenth embodiment, in addition to the insulating  
30 substrate 14 and the contact member 18, a reinforcement  
member 70A is provided.

The reinforcement member 70A is made of an  
elastic member having an insulating property (for  
examp , rubber, fl xible resin, or the like).  
35 Specifically, a holder 72 is provided in this  
embodiment. The reinforcement member 70A is provided  
on the holder 72, and then, the contact member 18 and

1 the insulating substrate 14 are stacked in the stated  
order.

5 In order to accommodate the variation of the  
heights of the bumps 2, it is necessary to form each  
connection portion 24 to be thin. The contact member  
18 is supported on the insulating substrate 14 except  
for the positions at which the contact member 18 faces  
the openings 16. Thus, the mechanical strength of the  
contact member 18 is ensured.

10 It is necessary that the connection portions  
24 are electrically connected with the bumps 2. For  
this purpose, the openings 16 are formed in the  
insulating substrate 14 at the positions at which the  
insulating substrate 14 faces the bumps 2. As a  
15 result, the thin connection portions 24 are exposed  
through the openings 16. Thus, the mechanical strength  
of the connection portions 24 is decreased.

20 In the fourteenth embodiment, the  
reinforcement member 70A supports the connection  
portions 24. Thereby, even if a strong force is  
applied to the connection portions 24, the  
reinforcement member 70A protects the connection  
portions 24. Thereby, plastic deformation of the  
connection portions 24 can be prevented. Therefore, a  
25 stable test can be always performed.

20 Further, in the fourteenth embodiment, the  
holder 72 is provided under the semiconductor testing  
device 10N. This holder 72 is made of a material  
having a low elastic deformation rate, such as, for  
example, metal, hard resin or the like. The holder 72  
is provided under the reinforcement member 70A, and  
supports the reinforcement member 70A.

35 As a result of providing the holder 72 for  
supporting the reinforcement member 70A, even if  
elastic deformation of the reinforcement member 70A  
occurs when the semiconductor device 1 is loaded on the  
semiconductor testing device 10N, excessive deformation

1 of the reinforcement member 70A and shifting of the  
reinforcement member 70A from a predetermined position  
can be prevented. Thereby, a stable electrical  
connection between the connection portions 24 and the  
5 bumps 2 can be provided.

A fifteenth embodiment of the present  
invention will now be described.

FIG.19 shows part of a semiconductor testing  
device 10P in the fifteenth embodiment of the present  
10 invention. In FIG.19, for the components/parts  
identical to those of the semiconductor testing devices  
10A and 10N in the first and fourteenth embodiments,  
shown in FIGS.1, 2 and 18, the same reference numerals  
are given and the descriptions thereof will be omitted.

15 In the semiconductor testing device 10P in  
the fifteenth embodiment, projections 74 are formed on  
a reinforcement member 70B at positions at which the  
reinforcement member 70B faces the connection portions  
24.

20 By forming the projections 74 on the  
reinforcement member 70B at the positions at which the  
reinforcement member 70B faces the connection portions  
24, the projections 74 are mainly deformed and the  
other portion of the reinforcement member 70B is not  
25 much deformed, when a strong force is applied to the  
connection portions 24. As a result, excessive  
deformation of the reinforcement member 70B and  
shifting of the reinforcement member 70B from a  
predetermined position can be prevented.

30 In each of the arrangements shown in FIGS.18  
and 19, when the connection portions 24 are deformed as  
a result of an external force being applied to the  
connection portions 24, the reinforcement member 70A or  
70B, which is in contact with the connecting portions  
35 24, prevents excess deformation of the connection  
portions 24. Thus, the connection portions 24 are well  
protected.

1        A sixteenth embodiment of the present  
invention will now be described.

5        FIG.20 shows part of a semiconductor testing  
device 10Q in the sixteenth embodiment of the present  
invention. In FIG.20, for the components/parts  
identical to those of the semiconductor testing devices  
10A and 10N in the first and fourteenth embodiments,  
shown in FIGS.1, 2 and 18, the same reference numerals  
are given and the descriptions thereof will be omitted.

10      In the semiconductor testing device 10Q in  
the sixteenth embodiment, reverse-conical depressions  
76 are provided on the reinforcement member 70C at the  
positions at which the reinforcement member 70C faces  
the connection portions 24.

15      By forming the reverse-conical depressions 76  
on the reinforcement member 70C at the positions at  
which the reinforcement member 70C faces the connection  
portions 24, in addition to the openings 16 formed in  
the insulating substrate 14, positioning of the bumps 2  
20      can be performed using the reverse-conical depressions  
76. Accordingly, positioning of the semiconductor  
device 1 with respect to the semiconductor testing  
device 10Q can be positively performed.

25      Because of the shape of the reverse-conical  
depression 76, the wall thereof is a taper surface.  
Accordingly, in comparison to a cylindrical depression  
or a rectangular depression each having a vertical  
wall, the connection portion 24 immediately comes into  
contact with the reinforcement member 70C when the  
30      connection portion 24 is deformed. Thereby, it is  
possible to prevent plastic deformation of the  
connection portion 24.

35      A seventeenth embodiment of the present  
invention will now be described.

FIG.21 shows part of a semiconductor testing  
device 10R in the seventeenth embodiment of the present  
invention. In FIG.21, for the components/parts

1 identical to those of the semiconductor testing devices  
10A and 10N in the first and fourteenth embodiments,  
shown in FIGS. 1, 2 and 18, the same reference numerals  
are given and the descriptions thereof will be omitted.

5 The semiconductor testing device 10R in the  
seventeenth embodiment uses an anisotropic conductive  
rubber as a reinforcement member 70D. The anisotropic  
conducting rubber is made as a result of mixing  
conducting metal powder into a flexible insulating  
10 material, and has characteristics of having  
conductivity in a pressed direction, that is, in the  
direction of a force application.

Accordingly, by using the anisotropic  
conducting rubber as the reinforcement member 70D, the  
15 reinforcement member 70D has two functions. The first  
function is to mechanically reinforce the connection  
portions 24. The second function is to electrically  
connect the connection portions 24 with pads 78  
provided on the testing board 40.

20 Thereby, plastic deformation of the connection portions  
24 can be prevented by the mechanically reinforcing  
function, and also, various kinds of wiring of the  
semiconductor testing device 10R can be performed by  
the electrically conductive function.

25 An eighteenth embodiment of the present  
invention will now be described.

FIG. 22A shows a side sectional elevation view  
of part of a semiconductor testing device 10S in the  
eighteenth embodiment of the present invention.

30 FIG. 22B shows a bottom view of part of the  
semiconductor testing device 10S. In FIGS. 22A and 22B,  
for the components/parts identical to those of the  
semiconductor testing devices 10A and 10N in the first  
and fourteenth embodiments, shown in FIGS. 1, 2 and 18,  
35 the same reference numerals are given and the  
descriptions thereof will be omitted.

In the semiconductor testing device 10S in

1 the eighteenth embodiment, a plurality of long and  
narrow through holes or slots 80 are formed in a  
reinforcement member 70E. The holes or slots 80 are  
formed approximately parallel with each other as shown  
5 in FIG.22B.

By forming the long and narrow through holes  
or slots 80 in the reinforcement member 70E, when the  
reinforcement member 70E is deformed as a result of the  
bumps 2 pressing the connection portions 24, the  
10 deformation is absorbed as a result of the long and  
narrow through holes or slots 80 being deformed. That  
is, when deformation occurs in portions 81A, 81B and  
81C which are defined by the long and narrow holes or  
slots 80, the deformation of each portion does not  
15 interact with the adjacent portions. Thereby,  
electrical connection between the connection portions  
24 and the bumps 2 can be positively ensured.

A nineteenth embodiment of the present  
invention will now be described.

20 FIG.23 shows a bottom view of part of a  
semiconductor testing device 10T in the nineteenth  
embodiment of the present invention. In FIG.23, for  
the components/parts identical to those of the  
semiconductor testing devices 10A and 10N in the first  
25 and fourteenth embodiments, shown in FIGS.1, 2 and 18,  
the same reference numerals are given and the  
descriptions thereof will be omitted.

In the semiconductor testing device 10T in  
the nineteenth embodiment, a net-shaped elastic member  
30 is used as a reinforcement member 70F. This net-shaped  
elastic member 70F is made from, for example, elastic  
wires (insulating wires) which are woven to have a net  
shape. Therefore, the reinforcement member 70F is  
flexibly deformed when a pressing force is applied  
35 thereto. This reinforcement member 70F is provided on  
the entire bottom surface of the insulating substrate  
14 including the bottom surfaces of the connection

1 portions 24.

In the nineteenth embodiment, by using the net-shaped elastic member as the reinforcement member 70F, in comparison to the arrangements of the 5 fourteenth through eighteenth embodiments shown in FIGS.18-22B, a space required for providing the reinforcement member 70F can be reduced. Thereby, the semiconductor testing device 10T can be miniaturized. Further, in comparison to the block-shaped 10 reinforcement members 70A-70E, the cost can also be reduced.

A twentieth embodiment of the present invention will now be described.

FIG.24 shows a side sectional elevation view 15 of part of a semiconductor testing device 10U in the twentieth embodiment of the present invention. In FIG.24, for the components/parts identical to those of the semiconductor testing devices 10A and 10N in the first and fourteenth embodiments, shown in FIGS.1, 2 20 and 18, the same reference numerals are given and the descriptions thereof will be omitted.

In the twentieth embodiment, a balloon-shaped member which contains air or a liquid is used as a reinforcement member 70G. In this embodiment, the 25 balloon-shaped member contains air. The balloon-shaped member 70G is connected to, for example, an air supply means such as an air pump. Air is supplied to the balloon-shaped reinforcement member 70G by the air supply means. This balloon-shaped reinforcement member 30 70G is provided in a depression formed in a holder 72. The insulating substrate 14 with the contact member 18 is placed on the balloon-shaped reinforcement member 70G, as shown in the figure.

In the above-described semiconductor testing 35 device 10U, by adjusting the amount of air contained in the balloon-shaped reinforcement member 70G, the elastic force of the balloon-shaped reinforcement

1 memb r 70G can be adjusted. Thereby, it is possible to  
set th elastic force of the balloon-shaped  
reinforcement member 70G to be appropriate for  
accommodating the variation of the heights of the bumps  
5 2 and plastic deformation of the connection portions 24  
can be prevented.

Further, by intentionally increasing and  
decreasing the internal pressure of the balloon-shaped  
reinforcement member 70G after the bumps 2 are  
10 connected to the connection portions 24, the connection  
portions 24 slide on the bumps 2, respectively.  
Thereby, even if oxide film and/or dust are present on  
the surfaces of the bumps 2 and the connection portions  
24, the oxide film and/or dust are removed as a result  
15 of the wiping effect provided by the sliding movement.  
Thereby, it is possible to make the surfaces of the  
bumps 2 and the connection portions 24 be in a good  
condition.

20 A twenty-first embodiment of the present  
invention will now be described.

FIG.25 shows the twenty-first embodiment. In  
this embodiment, the semiconductor testing device 10U  
in the twentieth embodiment shown in FIG.24 is applied  
to a testing socket 30B. In FIG.25, for the  
25 components/parts identical to those of the  
semiconductor testing devices 10A and 10U in the first  
and twentieth embodiments, shown in FIGS.1, 2 and 24,  
the same reference numerals are given and the  
descriptions thereof will be omitted.

30 As shown in FIG.25, the balloon-shaped  
reinforcement member 70G of the semiconductor testing  
device 10U is contained in the depression formed in the  
holder 72 which is a part of the testing socket 30B.  
The testing sock t 30B includes a lid portion 34 which  
35 is rotatably supported by a base member, which is fixed  
on a testing board 40, through a shaft 36. The lid  
portion 34 can be locked in the closed position by a

1 locking pin (not shown in the figure). FIG.25 shows  
th closed position of the lid portion 34.

2 In this locked state, the lid portion 34  
3 presses the semiconductor device 1 onto the  
4 semiconductor testing device 10U. Thereby, as  
described above, the bumps 2 formed on the  
semiconductor device 1 are connected with the  
connection portions 24 formed on the semiconductor  
testing device 10U. The semiconductor testing device  
10 is connected with the testing board 40 through the  
terminal portions 22 and contacts 84. In this  
condition, a predetermined test can be performed on the  
semiconductor device 1 through the testing board 40.

15 A pipe 86, which is connected with a high-  
pressure air source, is connected with the balloon-  
shaped reinforcement member 70G. At a middle position  
of the pipe 86 between the high-pressure air source and  
the balloon-shaped reinforcement member 70G, a valve  
device 88 is provided. This valve device 88 is, for  
20 example, a three-way valve. The valve device can  
switch the mode thereof between a mode (hereinafter,  
referred to as a 'supply mode') in which high-pressure  
air is supplied to the balloon-shaped reinforcement  
member 70G and a mode (hereinafter, referred to as a  
25 'discharge mode') in which air in the balloon-shaped  
reinforcement member 70G is discharged.

30 By appropriately switching the mode of the  
valve device 88 between the supply mode and the  
discharge mode as a result of controlling the valve  
device 88, it is possible to control the internal  
pressure of the balloon-shaped reinforcement member 70G  
to a desired pressure, and the above-mentioned wiping  
effect can be provided.

35 A twenty-second embodiment of the present  
invention will now be described.

FIG.26 shows a side sectional elevation view  
of part of a semiconductor testing device 10V in the

1 twenty-second embodiment of the present invention. In  
2 FIG.26, for the components/parts identical to those of  
3 the semiconductor testing device 10A in the first  
4 embodiment, shown in FIGS.1 and 2, the same reference  
5 numerals are given and the descriptions thereof will be  
omitted.

10 In the semiconductor testing device 10V in  
the twenty-second embodiment, an insulating substrate  
14A on which a contact member 18A is provided and an  
11 insulating substrate 14B on which a contact member 18B  
is provided are stacked with one another.

15 By using such a stacked-layer arrangement, a  
connection portion 24P of the contact member 18A is  
used for connecting with a bump 2A, a connection  
portion 24N of the contact member 18B is used for  
connecting with a bump 2B, and so forth. Thus, it is  
possible to reduce the number of bumps 2 (2A, 2B) which  
are connected with each layer (with the connection  
portions of each insulating substrate).

20 Thereby, variable wiring arrangements of the  
contact member 18A or 18B of each layer (on each  
insulating substrate 14A or 14B) can be provided.  
Accordingly, for the semiconductor device 1 which is of  
25 high density and has many bumps 2, an adequate  
semiconductor testing device 10V can be provided.

30 FIGS. 27A, 27B and 28 show a semiconductor  
testing device 110A in a twenty-third embodiment of the  
present invention. FIGS. 27A and 27B illustrate the  
arrangement and operation of the semiconductor testing  
device 110A. FIG. 28 shows a condition in which a  
35 contactor 111 is separate from a wiring substrate 115A.

As shown in the respective figures, in  
general, the semiconductor testing device 110A includes  
the contactor 111 and the wiring substrate 115A. A  
semiconductor device 120 is loaded on the semiconductor  
testing device 110A, a spherical connection terminal  
(referred to as a bump, hereinafter) 121 provided on

1 the semiconductor device 120 is electrically connected  
with the semiconductor testing device 110A, and a  
predetermined test is performed on the semiconductor  
device 120 through the semiconductor testing device  
5 110A.

In general, the contactor 111 includes a  
contact portion 112A, and an insulating substrate 113.  
The contact portion 112A is a tongue-shaped member,  
and, is formed of an elastically deformable conductive  
10 metal film such as a copper (Cu), an alloy of copper,  
or the like, for example. The contact portion 112A is  
provided at a position facing the bump 121 provided on  
the semiconductor device 120.

One end portion of the contact portion 112A  
15 is fixed to the insulating substrate 113, which will be  
described later, and the other end portion of the  
contact portion 112A extends on an opening 114 which is  
formed in the insulating substrate 113. Therefore, the  
contact portion 112A is supported and extends like a  
20 cantilever on the opening 114. Approximately the  
middle of the contact portion 112A is a connection  
portion 124A with which the bump 121 is connected.

The insulating substrate 113 is a single-  
layer, sheet-shaped resin substrate made of a resin,  
25 having the property of insulation, such as polyimide  
(PI) or the like, for example. The above-described  
contact portion 112A is formed on the top of the  
insulating substrate 113, and is supported by the  
insulating substrate 113. The opening 114 mentioned  
30 above is formed in the insulating substrate 113 at a  
position facing the contact portion 112. Forming of  
the contact portion 112A on the insulating substrate  
113 can be performed easily at a low cost, because a  
technique of manufacturing a flexible substrate or the  
35 like can be used.

The insulating substrate may comprise a  
flexible film made of resin and having the property of

1 insulation, and the contact portion may comprise a  
2 conductive metal layer having flexibility.

3 The wiring substrate 115A has a multilayer  
4 substrate arrangement, and includes a plurality (two,  
5 in the embodiment) of insulating layers 116A, 116B, and  
6 an internal connection terminal 117 (first connection  
7 terminal), an external connection terminal 118 (second  
8 connection terminal) and an interposer 119, which are  
9 formed in the insulating layers 116A, 116B, and so  
10 forth.

11 The insulating layers 116A, 116B are made of  
12 an insulating material such as glass epoxy or the like,  
13 for example. Further, the internal connection terminal  
14 117, external connection terminal 118 and interposer  
15 119 are formed through a plating technique, for  
16 example, in the insulating layers 116A, 116B. As the  
17 material of the internal connection terminal 117,  
18 external connection terminal 118 and interposer 119, a  
19 copper (Cu) is used.

20 The internal connection terminal 117 is  
21 formed on the surface (referred to as a top surface,  
22 hereinafter) of the wiring substrate 115A, on which  
23 surface the contactor 111 is loaded, at a position  
24 facing the contact portion 112A provided on the  
25 contactor 111. Accordingly, in the condition in which  
the contactor 111 is loaded on the wiring substrate  
115A, the internal connection terminal 117 faces the  
contact portion 112A via the opening 114.

26 The external connection terminal 118 is  
27 formed on the surface (referred to as a bottom surface,  
28 hereinafter) opposite to the above-mentioned top  
29 surface of the wiring substrate 115A. The external  
30 connection terminal 118 is a terminal which is used for  
connecting the semiconductor testing device 110A with a  
31 semiconductor tester or the like which performs an  
operation test on the semiconductor device 120.

32 The interposer 119 is used for electrically

1 connecting the internal connection terminal 117 with  
the external connection terminal 118. The interposer  
119 includes a plurality of internal electric wires  
119A, 119B and 119C. As a result of the internal  
5 connection terminal 117 and the external connection  
terminal 118 being connected with one another through  
the interposer 119, it is possible to improve  
flexibility in the position at which the internal  
connection terminal 117 is formed and the position at  
10 which the external connection terminal 118 is formed,  
such that these positions can be set arbitrarily.

The operation of the above-described  
semiconductor testing device 110A at a time of test  
will now be described. FIG. 27A shows a condition  
15 before the semiconductor device 120 is loaded on the  
semiconductor testing device 110A. In this embodiment,  
because the contact portion 112A has a cantilever-like  
arrangement, the contact portion 112A extends  
approximately straightly over the opening 114 before  
20 the semiconductor device 120 is loaded on the  
semiconductor testing device 110A. (Hereinafter, the  
condition shown in FIG. 27A will be referred to as a  
before-loaded condition.)

When the semiconductor device 120 is loaded  
25 on the semiconductor testing device 110A in the before-  
loaded condition, during the loading process, the bump  
121 is inserted into the opening 114. As a result, the  
contact portion 112A, which is made of an elastic  
material and has a cantilever-like arrangement, is  
30 elastically deformed, as shown in FIG. 27B, and, thus,  
the extending end 125 of the contact portion 112A comes  
into contact with the internal connection terminal 117  
of the wiring substrate 115A. Thereby, the bump 121 is  
electrically connected with the external connection  
35 terminal 118 via the contact portion 112A, internal  
connection terminal 117 and interposer 119.

A plurality of contact portions 112A, which

1 are provided on the insulating substrat 113 for a  
plurality of bumps 121 of th semiconductor device 120,  
respectively, are formed independently. Therefore,  
when the bumps 121 are inserted into the insulating  
5 substrate 113, the respective contact portions 112A are  
lowered independently. As a result, even when there is  
variation in the heights of the bumps 121, the  
respective contact portions 112A are deformed in  
proportion to the individual heights of the bumps 121,  
10 respectively. Thereby, it is possible to cause the  
contact portion 112A to be stably connected with the  
internal connection terminal 117.

Thus, in this embodiment, the internal  
connection terminal 117, which is connected with the  
15 contact portion 112A, is electrically connected with  
the external connection terminal 118 via the interposer  
119, which is provided in the wiring substrate 115A.  
As a result, by appropriately arranging the interposer  
119, it is possible to arbitrarily set a wiring path  
20 for electrically connecting the internal connection  
terminal 117 with the external connection terminal 118.

Thus, as a result of the wiring path from the  
contact portion 112A to the external connection  
terminal 118 being formed not in the contactor 111 but  
25 in the wiring substrate 115A, it is not necessary to  
produce a multilayer contactor, and the single-layer  
contactor 111 can be used. Thus, it is possible to  
reduce the cost of the contactor 111.

Further, a glass epoxy substrate, which is  
30 generally used as a wiring substrate in electronic  
equipment, can be used as the wiring substrate 115A.  
Therefore, it is possible to reduce the cost of the  
wiring substrate 115A. As a result, it is possible to  
reduce the cost of the semiconductor testing device  
35 110A.

Further, the contact portion 112A provided in  
the contactor 111 causes an electric signal from the

1 semiconductor device 120 to directly flow to the wiring  
substrat 115A. Th refore, even when the pitch of the  
bumps 21 is reduced, it is not necessary to provide  
electric wires 108A between membrane terminals 106A-1  
5 and 106A-2 (see FIG. 30). Accordingly, in the  
arrangement of this embodiment, it is possible to  
shorten the wire length between the internal connection  
terminal 117 and the external connection terminal 118,  
and to simplify the wiring arrangement, and, as a  
10 result, it is possible to use the semiconductor testing  
device 110A in a high-speed electrical test.

In the first embodiment, the wiring substrate  
comprises a multi-layer substrate. As a result, it is  
possible to achieve the contactor with a minute pitch  
15 of the contact portions, and, also, it is possible to  
provide the semiconductor testing device which can be  
used for a high-speed test.

Further, the semiconductor testing device  
110A has an arrangement such as, as shown in FIG. 28,  
20 to permit installation and removal of the contactor 111  
onto and from the wiring substrate 115A. Thereby, when  
the contact portion 112A is degraded as a result of the  
semiconductor testing device 110A being used repeatedly  
for testing many semiconductor devices 120, the  
25 contactor 111 is replaced with a new one. Thereby, it  
is possible to maintain reliability of the test  
performed on the semiconductor devices 120.

As a result of the cost of the contactor 111  
being reduced, as mentioned above, when replacement of  
30 the contactor 111 is needed, it is possible to perform  
replacement at a low cost. Therefore, the cost  
required for the maintenance can be reduced.

Advantages of the twenty-third embodiment  
will now be described in detail.

35 Recently, a highly integrat d and high-  
density semiconductor device having spherical  
connection terminals (bumps) has been produced. As a

1 result, bump size and pitch of the semiconductor device  
hav been a greatly reduc d. Therefor , achievement of  
a high-accuracy contactor which can come into contact  
with an arrangement of minute terminals of the  
5 semiconductor device, and maintenance of stable  
electrical connection with the minute terminals have  
been very important objects.

Further, as the pitch of the terminals of the  
semiconductor is reduced, it is necessary to use a  
10 multilayer wiring. Thereby the cost of the minute-  
pitch contactor increases.

Generally speaking, a semiconductor testing  
device has a contactor which is used for electrical  
connection with a semiconductor device. The contactors  
15 provided in the semiconductor testing devices are  
classified into so-called pogo-pin type ones in which  
pins come into contact with terminals of the  
semiconductor device using spring forces, and membrane-  
type ones in which spherical-surface terminals which  
20 are to be connected with the spherical connection  
terminals (bumps) are formed on a thin insulation film  
through, for example, plating or the like.

FIG. 29A shows a pogo-pin type semiconductor  
testing device 101A. In the semiconductor testing  
25 device 101A, coil springs 103 are provide through a  
pair of substrates 102a, 102b. By using the elastic  
forces of the coil springs 103, pogo pins 104 are  
lifted and lowered, and, thus, the pogo pins 104 come  
into contact with the bumps (not shown in the figure)  
30 provided on the semiconductor device.

However, because the coil springs 103 are  
used in the semiconductor testing device 101A, it is  
not possible to use the semiconductor testing device  
101A for a high-density semiconductor devic . In order  
35 to eliminat this probl m, the membrane-type  
semiconductor testing device 101B has been developed.

The membrane-type semiconductor testing

1 device 101B has a contactor in which spherical-surface  
2 terminals 106A (which is referred to as membrane  
3 terminals) are formed through plating. The membrane  
4 terminals 106A are connected with the bumps (not shown  
5 in the figure) of the semiconductor device, and a test  
of the semiconductor device is performed.

Further, on the top surface of an insulating  
substrate 105A, the electric wires 108A, which are  
connected with the membrane terminals 106A,  
10 respectively, are formed. The electric wires 108A  
connected with the membrane terminals 106A extend to  
peripheral positions of the insulating substrate 105A.  
Further, an elastic member 109A is provided below the  
15 contactor, and, even if variation in the heights of the  
bumps of the semiconductor device exists, positive  
electrical connection is achieved as a result of the  
elastic member 109A being elastically deformed  
appropriately.

However, in the membrane-type semiconductor  
20 testing device 101B, the electric wires 108A are laid  
on the top surface of the insulating substrate 105A.  
As a result, as the terminal pitch is reduced, it is  
not possible to provide a sufficient area in which the  
electric wires 108A are laid.

25 That is, in the arrangement in which the  
electric wires 108A are laid only on the top surface of  
the insulating substrate 105A, when a high-density  
semiconductor testing device 101B is produced, the  
30 pitch between each pair of adjacent membrane terminals  
106A is reduced, and, also, the number of electric  
wires 108A increases. Therefore, as shown in FIG. 30,  
it is necessary to provide many electric wires 108A  
between adjacent membrane terminals 106A. In the  
example shown in FIG. 30, three wires are provided  
35 between the membrane terminals 106A-1 and 106A-2.  
However, the number of electric wires 108A which can be  
provided between the pair of adjacent membrane

1      terminals 106A-1, 106A-2, the pitch of which is  
reduced, is naturally limited.

5      Therefore, as in a semiconductor testing  
device 101C shown in FIG. 31, provision of a multilayer  
contactor can be considered. In the semiconductor  
testing device 101C shown in the figure, 3 layers of  
insulating substrates 105B are stacked. On each  
insulating substrate 105B, an electric wire 108B is  
formed. Further, below the contactor, an elastic  
10     member 109B is provided, and, even if variation in the  
heights of the bumps of the semiconductor device  
exists, positive electrical connection can be achieved  
as a result of the elastic member 109B being  
elastically deformed appropriately.

15     In this arrangement, the electric wire 108B  
is formed on each insulating substrate 105B.  
Therefore, flexibility in layout of the electric wires  
108B is improved, and, therefore, it is possible to  
widen the pitch between adjacent electric wires 108B.  
20     Accordingly, when the pitch between adjacent membrane  
terminals 106B is reduced, it is possible to widen the  
space between adjacent electric wires 108B. As a  
result, the semiconductor testing device 101C can be  
used for a high-density semiconductor device.

25     However, manufacturing of the contactor as a  
result of the plurality of insulating substrates 105B  
and the membrane terminals 106B being stacked is  
technically very difficult, and development thereof is  
difficult. As a result, when such an arrangement is  
30     manufactured, the contactor is very expensive.

35     Further in the membrane-type semiconductor  
testing device 101C, generally, when the membrane  
terminals 106B are degraded (movement of solder,  
adhesion of foreign bodies, etc.), or damaged, due to  
connection with the bumps, the contactor is replaced.  
However, when the contactor is expensive as mentioned  
above, the cost required for testing a semiconductor

1 device is very high.

5 In order to eliminate these problems, a method of providing a contactor of one layer or two layers, providing an anisotropic conductive rubber below the contactor, and connecting the anisotropic conductive rubber with the contactor can be considered. However, the anisotropic conductive rubber is very expensive, there is a limit to reduction of the pitch of a minute-pitch arrangement, and, also, durability 10 thereof is not sufficient.

15 The twenty-third embodiment is directed to elimination of the above-described problems. In this embodiment, it is possible to provide a high-density, low-cost semiconductor testing device.

20 A twenty-fourth embodiment of the present invention will now be described.

25 FIG. 32 shows a semiconductor testing device 110B in the twenty-fourth embodiment of the present invention. In FIG. 32, the same reference numerals are given to parts/portions the same as those of the semiconductor testing device 110A in the twenty-third embodiment shown in FIGS. 27A, 27B and 28, and descriptions thereof are omitted. To respective embodiments (twenty-fifth through thirty-third 30 embodiments), which will be described later, the same manner is applied.

35 In the semiconductor testing device 110B in this embodiment, a contact portion 112B has a thickness or a hardness such that, when the bump 121 is connected with the contact portion 112B, the contact portion 112B can break the oxide film formed on the surface of the bump 121.

As is well known, in a case where the bump 121 is made of solder, the oxide film is formed on the 35 surface of the bump 121. Because the oxide film has the property of insulation, the electric connectability between the bump 121 and the contact portion 112B is

1 degraded when the oxide film formed is 1 ft as it is.

As a result of the thickness or the hardness of the contact portion 112B being increased, as in this embodiment, the contact portion 112B is able to break  
5 the oxide film formed on the surface of the bump 121. More specifically, when the semiconductor device 120 is loaded on the contactor 111 and the bump 121 slides on the contact portion 112B along the surface of the contact portion 112B, the contact portion 112B wipes  
10 the bump 121, and can break the oxide film on the bump 121.

Thereby, it is possible to improve the electrical connectability between the contact portion 112B and the bump 121, and a stable contact condition  
15 can be maintained during the test. As a specific example of the contact portion 112B, in a case where a copper (Cu) is used as the material thereof, it is possible to break the oxide film as a result of the thickness of the contact portion 112B being on the  
20 order of 15  $\mu\text{m}$  through 200  $\mu\text{m}$ .

The twenty-fifth embodiment of the present invention will now be described.

FIGS. 33A and 33B show a semiconductor testing device 110C in the twenty-fifth embodiment of the present invention. In the semiconductor testing device 110C, an extending portion 122 is formed in the opening 114. Specifically, as shown in FIG. 33B, the extending portion 122 extends inside of the opening 114 by a length indicated by L from the edge of the opening  
25 114.

The extending portion 122 is formed integrally with the insulating substrate 113, at the position facing the contact portion 112A. The contact portion 112A is partially supported by the extending portion 122.

As a result of providing the extending portion 122 which partially supports the contact

1 portion 112A, it is possible to adjust the reaction  
2 force which is developed in the contact portion 112A as  
3 a result of the contact portion 112A being pushed by  
4 the bump 121. The adjustment of the reaction force can  
5 be performed as a result of the length L of the  
6 extending portion 122 being adjusted. As the extending  
7 portion 122 is elongated, the contact portion 112A is  
8 not likely to bend, and the reaction force increases.  
9 Conversely, as the extending portion 122 is shortened,  
10 the reaction force decreases.

Thus, in this embodiment, the contact pressure developed between the contact portion 112A and the bump 121 when the semiconductor device 120 is loaded on the contactor 111 can be adjusted to an appropriate value. Thereby, it is possible that the contact portion 112A and the bumps are connected with one another in a good condition.

The twenty-sixth embodiment of the present invention will now be described.

20 FIG. 34 shows a semiconductor testing device 110D in the twenty-sixth embodiment of the present invention. In the semiconductor testing device 110D, a projection 123A, which comes into contact with the contact portion 112A, is formed in the opening 114.

25 As a result of the projection 123A being formed in the opening 114, when the contact portion 112A is bent and thus a first portion of the contact portion 112A is moved as a result of the first portion being pushed by the bump 121 at the time of connection, 30 the contact portion 112A comes into contact with the projection 123A at a certain height (the height of the projection 123A), and a second portion of the contact portion 112A is further moved, which second portion is a portion extending from a position to the extending 35 end 125 of the contact portion 112A, at which position the contact portion 112A is supported by the projection 123A. Accordingly, as a result of adjusting the height

1 and the position of the projection 123A, it is possible  
to adjust the contact pressure which is applied to the  
bump 121 by the contact portion 112A. As a result, it  
is possible to achieve the contact pressure which is  
5 optimum for the electrical connection between the  
contact portion 112A and the bump 121. Thereby, it is  
possible that the contact portion 112A and the bump 121  
are connected with one another in a good condition.

This projection 123A can be made of a  
10 conductive metal (for example, gold, palladium, nickel,  
or the like), resin (for example, polyimide, epoxy, or  
the like), or an elastic material (for example, a  
conductive rubber in which carbon or the like is mixed,  
a sponge, or the like).

15 When the projection 123A is made of a  
conducting material, electrical connection between the  
contact portion 112A and the internal connection  
terminal 117 can be performed not only through the  
extending end 125 of the contact portion 112A but also  
20 through the projection 123A. As a result, it is  
possible to positively perform the electrical  
connection between the contact portion 112A and the  
internal connection terminal 117.

When the projection 123A is made of an  
25 elastic material, as a result of the hardness of the  
projection 123A being adjusted, it is possible that an  
appropriate contact pressure is developed between the  
bump 121 and the contact portion 112A. Thereby, stable  
electrical connection can be achieved.

30 Further, in addition to the reaction force  
developed in the contact portion 112A when the bump 121  
pushes the contact portion 112A, the elastic  
restoration force developed as a result of the  
projection 123A itself being elastically deformed is  
35 applied to the bump 121 as the reaction force.  
Therefore, in this embodiment, even in a case where a  
sufficient contact pressure cannot be obtained only by

1 the reaction force developed in the contact portion  
112A, the contact pressure required for an appropriate  
electrical connection can be positively developed by  
the projection 123A. As a result, it is possible to  
5 achieve stable electrical connection.

The adjustment of the contact pressure can be  
performed in the range of hardness  $H_R$  C10 through 100  
as a result of the hardness of the material and/or the  
height of the projection 123A being adjusted  
10 appropriately.

In the case where the projection 123A is made  
of metal, the projection 123A can be formed through  
plating, wire bonding, or the like, for example. In  
the case where the projection 123A is made of resin,  
15 the projection 123A can be formed through potting or  
the like, for example.

When the projection 123A is formed through  
plating, in a case where the contactor 111 is used for  
testing the semiconductor device 120 on which a pattern  
20 is formed with a narrow pitch and the bumps are  
provided in high density, respective projections 123A  
can be manufactured in high accuracy, in comparison to  
a case where respective projections 123A are formed  
through adhesion.

25 When the projection 123A is formed through  
wire bonding, because it is possible to use an existing  
wire bonder, it is possible to form the projection 123A  
at a low cost. Further, for a case where merely a  
small number of semiconductor testing devices are  
30 produced for each type, it is possible to perform  
production for the respective types flexibly.

Further, when the projection 123A is formed  
through potting, because the projection 123A can be  
formed through inexpensive equipment, it is possible to  
35 reduce the cost required for forming the projection  
123A. Further, for a case where merely a small number  
of semiconductor testing devices are produced for each

1 type, it is possible to perform production for the  
respective types flexibly.

5 The twenty-seventh and twenty-eighth  
embodiments of the present invention will now be  
described.

10 FIG. 35 shows a semiconductor testing device  
110E in the twenty-seventh embodiment of the present  
invention. FIG. 36 shows a semiconductor testing  
device 110F in the twenty-eighth embodiment of the  
present invention. In the semiconductor testing device  
110E, a spherical projection 123B is used. In the  
semiconductor testing device 110F, a ring-shaped  
projection 123C (for example, an O ring) is used.

15 As a result of the spherical projection 123B  
or the ring-shaped projection 123C being used, it is  
possible to provide the projection 123B or 123C in the  
opening 114 easily. Each of the projections 123B and  
123C has a function similar to that of the projection  
123A in the twenty-sixth embodiment, and, also,  
20 materials and properties the same as those of the  
projection 123A can be applied to each of the  
projections 123B and 123C.

25 The shape of the contact portion will now be  
considered. In each of the twenty-third through  
twenty-eighth embodiments, the contact portion 112A or  
112B has a simple tongue-like shape. However, the  
contact portion is used for the electrical connection  
with the internal connection terminal 117. Therefore,  
30 as a result of appropriately changing the shape of the  
contact portion, it is possible to improve the  
electrical connectability between the contact portion  
and the internal connection terminal 117. Variant  
examples of the shape of the contact portion will now  
be described.

35 FIGS. 37A and 37B show contact portions 112C  
and 112D which are first and second variant examples,  
respectively. A pointed-end portion is formed at an

1 extending-end portion of each of the contact portions  
112C and 112D so that the electrical connectability  
with the internal connection terminal 117 is improved.

5 A point portion 125A as the pointed-end  
portion is formed at the extending-end portion of the  
contact portion 112C shown in FIG. 37A. As a result of  
the point portion 125A being formed at the extending-  
end portion of the contact portion 112C and thus being  
sharpened sharply, the point portion 125A sticks in or  
10 slides on the internal connection terminal 117, so that  
the oxide film formed on the surface of the internal  
connection terminal 117 can be broken. As a result, it  
is possible to perform stable electrical connection  
between the contact portion 112C and the internal  
15 connection terminal 117. The point portion 125A can be  
formed through etching or the like, for example.

A saw-tooth portion 125B is formed as the  
pointed-end portion at the extending-end portion of the  
contact portion 112D shown in FIG. 37B. As a result of  
20 the saw-tooth portion 125B being formed at the  
extending-end portion of the contact portion 125B and  
thus many point portions being provided there, it is  
possible that the oxide film formed on the surface of  
the internal connection terminal 117 is broken at a  
25 plurality of positions. Thereby, more stable  
electrical connection can be performed between the  
contact portion 112D and the internal connection  
terminal 117. This saw-tooth portion 125B can also be  
formed through etching or the like.

30 With reference to FIGS. 38A through 48,  
contact portions 112E through 112P, which are third  
through thirteenth variant examples, respectively, will  
now be described. FIGS. 38A, 39A, 40A, 41A, 42A, 43A,  
44A, 45A, 46A and 47A show side elevational sectional  
35 views of the contact portions 112E through 112N,  
respectively, and FIGS. 38B, 39B, 40B, 41B, 42B, 43B,  
44B, 45B, 46B and 47B show bottom views of essential

1 portions of the contact portions 112E through 112N,  
respectively.

When the contactor provided with each of the  
third through twelfth variant examples of the contact  
5 portions is provided on the wiring substrate 115A, as  
shown in FIG. 38A, spacers 170 are provided between the  
contactor provided with the contact portion and the  
wiring substrate 115A provided with the internal  
connection terminal 117. When the bump 121 is inserted  
10 into the opening 114, the connection portion of the  
contact portion is deformed and comes into contact with  
the internal connection terminal 117, as shown in the  
figure. For the sake of simplification, the spacers  
15 170, internal connection terminal 117 and the  
insulating layers 116A, 116B will be omitted in FIGS.  
39A, 40A, 41A, 42A, 43A, 44A, 45A, 46A and 47A.

FIGS. 38A and 38B show the contact portion  
112E which is the third variant example. In this  
variant example, the contact portion 112E includes a  
20 pair of cantilever portions 156. Specifically, a ring  
portion 154 is formed at a connection portion 124B of  
the contact portion 112E, and, as shown in FIG. 38B,  
the pair of cantilever portions 156 extend from  
opposite positions of the ring portion 154 toward the  
25 center of the ring portion 154.

In this variant example, at a time of  
testing, the cantilever portions 156 come into contact  
with the bump 121 at both sides thereof. Thereby, it  
is possible that the bump 121 is held stably.  
30 Therefore, it is possible to increase the strength of  
the connection portion 124B, and it is possible to  
prevent the connection portion 124B from being deformed  
plastically.

FIGS. 39A and 39B show the contact portion  
35 112F which is the fourth variant example. In this  
variant example, a connection portion 124C is a forked  
cantilever portion 158. In this variant example, the

1 connection portion 124C is likely to be deformed. As a  
result, even if variation in the height of the bump 121  
exists, positive electrical connection is achieved as a  
result of the connection portion 124C being deformed  
5 appropriately.

However, because the connection portion 124C  
is likely to be deformed, in a case where the contact  
portion 112F is made of copper (Cu), plastic  
deformation of the connection portion 124C is likely to  
10 occur. Accordingly, in this variant example, it is  
preferable that the contact portion 112F be made of a  
material which has elasticity and also high electric  
conductivity.

FIGS. 40A and 40B show the contact portion  
15 112G which is the fifth variant example. Each of the  
above-described contact portions 112A through 112F has  
a cantilever shape. In contrast to this, the contact  
portion 112G of this variant example includes a portion  
160 supported at both ends thereof.

20 Specifically, a connection portion 124D has  
the portion 160 supported at both ends thereof, and  
each of both ends of the portion 160 is integrally  
connected with a ring portion 154. As a result of the  
connection portion 124D having the portion 160  
25 supported at both ends thereof, the mechanical strength  
of the connection portion 124D can be increased.  
Thereby, the connection portion 124D can be prevented  
from being degraded due to long-term use.

FIGS. 41A and 41B show the contact portion  
30 112H which is the sixth variant example. In the  
contact portion 112H of this variant example, an  
opening (slit) 163 is formed at the center line of the  
connection portion 124E. Thus, a pair of portions 162,  
each supported at both ends thereof, are formed. By  
35 forming the pair of portions 162 in the connection  
portion 124E, the amount of deformation of the portions  
162 can be increased. Thereby, variation in the height

1 of the bump 121 can be effectively accommodated.

Further, by providing the opening 163 between the portions 162, a bottom-end portion of the bump 121 is located in the opening 163 in the loaded condition. 5 Thereby, movement of the bump 121 on the connection portion 124E can be prevented. Accordingly, the bump 121 (semiconductor device 120) can be positively positioned on the contact portion 112H (contactor 111).

In the sixth variant example, a bottom 10 portion of the bump is inserted into the opening 163 when the bump is connected with the contact portion. Thereby, it is possible to control occurrence of deformation of the bottom portion of the bump. Further, because the contact area between the bump and 15 the contact portion increases, it is possible to achieve positive electrical connection between the bump and the contact portion.

FIGS. 42A and 42B show the contact portion 112I which is the seventh variant example. In the 20 contact portion 112I of the seventh variant example, a straight-line slit 126A is formed in a connection portion 124F so that the connection portion 124F is deformable.

The possible amount of deformation of the 25 connection portion 124F of this variant example is less than the possible amount of deformation of the connection portion 124E of the sixth variant example. However, the mechanical strength of the connection portion 124F is higher than that of the connection portion 124E. Accordingly, in accordance with the 30 material of the bump 121 (for example, whether the bump 2 is made of solder or gold, and so forth), an appropriate one of the connection portions 124E and 124F may be selected.

35 In the seventh variant example, a bottom portion of the bump is inserted into the slit 126A when the bump is connected with the contact portion.

1 Ther by, it is possible to control occurrence of  
deformation of the bottom portion of the bump.  
Further, because the contact area between the bump and  
the contact portion increases, it is possible to  
5 achieve positive electrical connection between the bump  
and the contact portion.

FIGS. 43A and 43B show the contact portion  
112J which is the eighth variant example. In this  
variant example, a circular opening 126B is formed at  
10 the center of a connection portion 124G. The possible  
amount of deformation of the connection portion 124G is  
less than that of the connection portion 124F in the  
seventh variant example, while the mechanical strength  
of the connection portion 124G is higher than the  
15 connection portion 124F. Accordingly, as mentioned  
above, an appropriate one of the connection portions  
124E, 124F and 124G may be selected. Further, because  
the opening 126B is located at the center of the  
connection portion 124G and also has the circular  
20 shape, the bump 121 is always located at the center of  
the connection portion 124G. Accordingly, the bump 121  
(semiconductor device 120) can be positively positioned  
on the contact portion 112J (contactor 111).

In the eighth variant example, a bottom  
25 portion of the bump is inserted into the opening 126B  
when the bump is connected with the contact portion.  
Thereby, it is possible to control occurrence of  
deformation of the bottom portion of the bump.  
Further, because the contact area between the bump and  
30 the contact portion increases, it is possible to  
achieve positive electrical connection between the bump  
and the contact portion.

FIGS. 44A and 44B show the contact portion  
112K which is the ninth variant example. In this  
35 variant example, many small-diameter circular openings  
126C are formed in a connection portion 124H. By  
forming the large number of circular openings 126C in

1 the connection portion 124H, similar to the above-  
described variant examples, the connection portion 124H  
is deformable. The possible amount of deformation can  
be adjusted by appropriately selecting the number of  
5 the circular openings 126C and the diameter of each  
circular opening 126C.

Further, by forming the large number of  
circular openings 126C, when the bump 121 is pressed  
onto the connection portion 124H, the edges of many of  
10 the circular openings 126D come into contact with and  
cut into the bump 2. Thereby, the electrical  
connectability between the connection portion 124H and  
the bump 121 can be improved.

FIGS. 45A and 45B show the contact portion  
15 112L which is the tenth variant example. In the above-  
described respective variant examples, the connection  
portions 124B through 124H are integrally formed in the  
contact portions 112E through 112K, respectively. In  
20 contrast to this, in this variant example, a connection  
portion 124I is a member different from the contact  
portion 112L.

By using the connection portion 124I which is  
the member different from the contact portion 112L, it  
is possible to separately select the material of the  
25 contact portion 112L and the material of the connection  
portion 124I. Accordingly, it is possible to select a  
material that is optimum for the function of the  
contact portion 112L and to select a material that is  
optimum for the function of the connection portion  
30 124I. In the contact portion 112L shown in FIGS. 45A  
and 45B, in order to set the possible amount of  
deformation of the connection portion 124I to be large,  
the connection portion 124I is a foil-like terminal  
164. In this variant example, the foil-like terminal  
35 164 is made of aluminum (Al), and the contact portion  
112L is made of copper (Cu).

FIGS. 46A and 46B show the contact portion

1 112M which is the eleventh variant example. In this  
variant example, similar to the above-described tenth  
variant example, a connection portion 124J is a member  
different from the contact portion 112M. In this  
5 variant example, as shown in the figures, the  
connection portion 124J is a cantilever-shaped wire  
166.

The cantilever-shaped wire 166 is formed  
using the wire-bonding technique. Specifically, wire  
10 bonding is performed at a position on the contact  
portion 112M in close proximity to the opening 114  
using a wire-bonding apparatus. Then, after a  
predetermined length of wire is pulled out, the wire is  
cut. As a result, the wire is in a condition indicated  
15 by the broken line in FIG.46A.

Then, the wire is bent to a position below  
the opening 114. Thus, the cantilever-shaped wire 166  
is formed (indicated by the solid line in FIG.46A). By  
forming the connection portion 124J using the wire-  
bonding technique, the connection portion 124J is  
20 easily and efficiently formed, and also, the cost  
therefor can be reduced. In this variant example, the  
connection portion 124J is the cantilever-shaped wire  
166, one end of the wire 166 being fixed and the other  
end of the wire 166 being free. Thereby, the possible  
25 amount of deformation of the cantilever-shaped wire 166  
is relatively large. As a result, even if the  
variation of the height of the bump 121 is large, the  
variation can be accommodated.

30 FIGS. 47A and 47B show the contact portion  
112N which is the twelfth variant example. In this  
variant example, similar to the above-described  
eleventh variant example, the connection portion 124K  
is a wire 168. Although the connection portion 124J is  
35 the cantilever-shaped wire 166 in the eleventh variant  
example, the connection portion 124K is the wire 168  
supported at both ends thereof in the twelfth variant

1 example.

The wire 166 supported at both ends thereof is formed also using the wire-bonding technique. Specifically, first bonding is performed at a position 5 on a frame portion 154 of the contact portion 112N in close proximity to the opening 114. Then, after the wire is pulled out a predetermined length, second bonding is performed at a position on the frame portion 154 opposite to the position of the first bonding. 10 Thereby, each of the both ends of the wire 168 is fixed to the frame portion 154. By this arrangement, the mechanical strength of the connection portion 124K in the twelfth variant example is higher than that of the connection portion 124J in the eleventh variant 15 example.

Although the single wire 168 supported at both ends thereof is used in this variant example, two wires 168, each supported at both ends thereof, may be used. The two wires 168 are arranged so as to cross to 20 form a cross shape. In this arrangement, the effect provided by the twelfth variant example can also be provided, and, also, movement of the bump 121 can be prevented. Accordingly, the bump 121 (semiconductor device 120) can be positively positioned on the contact portion (contactor 111). 25

FIG. 48 shows the contact portion 112P which is the thirteenth variant example. In this variant example, roughened surfaces 127A are formed on the top surface (the surface with which the bump 121 comes into contact) and the portion (the bottom surface) which comes into contact with the internal connection terminal 117, respectively, of the contact portion 112P. Further, a roughened surface 127B is formed on the top surface of the internal connection terminal 30 117. The roughened surfaces 127A, 127B may be formed as a result of forming minute projections by changing a plating condition; as a result of roughening these 35

1       surfaces by striking small particles against these  
surfaces through blast; as result of stamping on these  
surfaces using a member having a roughened surface, or  
the like.

5       In this variant example, in the case where  
the roughened surface 127A is formed on the top surface  
of the contact portion 112P, the oxide film formed on  
the surface of the bump 121 is broken by the roughened  
surface 127A when the bump 121 is connected with the  
10      contact portion 112P. Thereby, stable electrical  
connection can be provided between the contact portion  
112P and the bump 121.

15      In the case where the roughened surface 127A  
is formed on the portion (the bottom surface) which  
comes into contact with the internal connection  
terminal 117, the oxide film formed on the surface of  
the internal connection terminal 117 is broken by the  
roughened surface 127A when the contact portion 112P  
comes into contact with the internal connection  
20      terminal 117. Thereby, stable electrical connection  
can be provided between the contact portion 112P and  
the internal connection terminal 117.

25      Further, as a result of the roughened surface  
127B being formed on the internal connection terminal  
117, even if the oxide film is formed on the contact  
portion 112P, this oxide film can be broken by the  
roughened surface 127B when the contact portion 112P  
comes into contact with the internal connection  
terminal 117. Thereby, stable electrical connection  
30      can be provided between the contact portion 112P and  
the internal connection terminal 117.

35      When each of the roughened surfaces 127A,  
127B has the average roughness of 0.1 through 100  $\mu\text{m}$ ,  
the effects provided by the roughened surfaces are  
large.

Further, in the thirteenth variant example  
shown in FIG. 48, the roughened surface 127A is formed

- 1 on each of both top and bottom surfaces of the contact portion 112P. However, it is also possible that the roughened surface 127A is formed on only one of the top and bottom surfaces of the contact portion 112P.
- 5 Further, although the roughened surface 127B is formed on the entire surface of the internal connection terminal 117 in the thirteenth variant example, it is also possible that the roughened surface 127b is formed only on the area with which the contact portion 112P is connected.

The twenty-ninth and thirtieth embodiments of the present invention will now be described.

- 15 FIG. 49 shows a semiconductor testing device 110G in the twenty-ninth embodiment of the present invention. FIG. 50 shows a semiconductor testing device 110H in the thirtieth embodiment of the present invention. In each of these embodiments, a positioning arrangement, for positioning of the contactor 111 with respect to the wiring substrate 115A when the contactor 20 111 is loaded on the wiring substrate 115A, is provided.

- 25 As described above with reference to FIG. 28, the semiconductor testing device has an arrangement such as to permit installation and removal of the contactor 111 onto and from the wiring substrate 115A. Thereby, when the contact portion is degraded as a result of the semiconductor testing device being used repeatedly for testing many semiconductor devices 120, the contactor 111 is replaced with a new one. Thereby, 30 it is possible to always perform stable testing. When the contactor 111 is replaced with a new one, it is necessary to accurately position the contact portion with respect to the internal connection terminal 117. Therefore, it is necessary to accurately load the contactor 111 on the wiring substrate 115A. For this purpose, in each of the semiconductor testing devices 35 110G, 110H in the twenty-ninth and thirtieth

1       embodiments, the positioning arrangement for  
positioning the contactor 111 with respect to the  
wiring substrate 115A is provided.

5       In the semiconductor testing device 110G  
shown in FIG. 49, the positioning arrangement includes  
first positioning holes 129 formed in the insulating  
substrate 113 of the contactor 111, second positioning  
holes 130 formed in the wiring substrate 115A, and  
positioning pins 131 which engage with the respective  
10      positioning holes 129, 130. Positioning of the  
contactor 111 (contact portion 112A) with respect to  
the wiring substrate 115A (internal connection terminal  
117) is performed as a result of each of the  
positioning pins 131 being inserted into, so as to be  
15      fitted into, the respective one of positioning holes  
129 and the respective one of the positioning holes 130  
simultaneously so that the positioning pins 131 engage  
with the positioning holes 129, 130.

20      In the semiconductor device 110H shown in  
FIG. 50, the positioning arrangement includes  
positioning holes 132 formed in the insulating  
substrate 113 and positioning projections 133 formed on  
the top surface of the wiring substrate 115A.  
Positioning of the contactor 111 (contact portion 112A)  
25      with respect to the wiring substrate 115A (internal  
connection terminal 117) is performed as a result of  
the positioning projections 133 being inserted into, so  
as to be caused to engage with, the positioning holes  
132, respectively.

30      In each of the semiconductor testing devices  
110G and 110H in the respective embodiments, merely  
through a process of causing the positioning pins 131  
to engage with the positioning holes 129, 130, or  
merely through a process of causing the positioning  
35      projections 133 to engage with the positioning holes  
132, it is possible to position the contactor 111 with  
respect to the wiring substrate 115A. Therefore,

1 through the simple arrangement and simple operation, positioning of the contact portion 112A with respect to the internal connection terminal 117 can be positively performed.

5 Thus, positioning of the opening and the contact portion provided in the contactor with respect to the internal connection terminal provided on the wiring substrate can be easily and positively performed.

10 Each of these positioning holes 129, 130, 132 may be formed through drilling, punching, or etching, or using a laser. Further, if it is necessary to perform positioning more accurately than the above-described positioning methods, it is possible that a 15 positioning arrangement includes a camera, an image recognizing unit, and so forth, so that positioning is performed through image recognition.

The thirty-first embodiment of the present invention will now be described.

20 FIG. 51 shows a semiconductor testing device 110I in the thirty-first embodiment of the present invention. In this embodiment, only the opening 114 is provided at a position at which no electrical connection between the contactor 111 and the bump 121 is necessary, that is, a non-connection portion 134 having no contact portion 112A is provided.

25 The semiconductor device 120 loaded on the semiconductor testing device 110I has many bumps 121. However, as is well known, when a test is performed on this semiconductor device 120, all the bumps 121 are not necessarily used for causing test signals to flow therethrough. (Hereinafter, the bumps, which are not used for causing test signals to flow therethrough, will be referred to as connection-unnecessary bumps 30 121A.)

35 In this embodiment, the non-connection portion 134, for which no contact portion 112A is

1 provided, is provided at the position facing the  
connection-unnecessary bump 121A. Thereby, the  
connection-unnecessary bump 121A do not come into  
contact with a contact portion 112A. As a result of  
5 the non-connection portion 134 being provided, the  
connection-unnecessary bump 121A is merely located in  
the opening 114 and does not come into contact with the  
contactor 111 when the semiconductor device 120 is  
loaded on the semiconductor testing device 110I.

10 Therefore, the connection-unnecessary bump  
121A can be prevented from being deformed in the non-  
connection portion 134. Further, the reaction force  
developed in the contact portion 112A does not exist in  
the non-connection portion 134. Therefore, the pushing  
15 force to be applied to the semiconductor device 120, by  
which force the semiconductor device 120 is pushed to  
the semiconductor testing device 110I when the  
semiconductor device 120 is loaded on the semiconductor  
testing device 110I, can be reduced. As a result, the  
20 loading work is easier.

The thirty-second embodiment of the present  
invention will now be described.

FIG. 52 shows a partial plan view of the  
semiconductor testing device 110J in the thirty-second  
25 embodiment of the present invention. As shown in the  
figure, in the semiconductor testing device 110J in  
this embodiment, a direction in which each contact  
portion 112A extends is a direction normal to a  
direction toward the center position (the center  
30 position of the semiconductor device) in a condition in  
which the semiconductor device has been loaded on the  
semiconductor testing device 110J.

This will now be described by considering the  
contact portion 112A-1 shown in the figure as an  
example. When a line segment X is drawn between the  
35 center position of the semiconductor device and the  
center position of the contact portion 112A-1, the

1 direction in which the contact portion 112A-1 extends, that is, the direction in which the extending end 125 of the contact portion 112A-1 faces, is the direction indicated by the arrow Y. The direction indicated by 5 the arrow Y is perpendicular to the line segment X. Thus, each contact portion 112A is arranged so as to line on a circumference of an imaginary circle, the center of which circle is the center position of the semiconductor device.

10 The contactor 111 and the semiconductor device 120 have inherent rates of thermal expansion, and the rate of thermal expansion of the contactor 111 is different from the rate of thermal expansion of the semiconductor device 120. Therefore, when a test, such 15 as burn-in, in which heating is performed, is conducted, a difference occurs in the amounts of thermal expansion between the contactor 111 and the semiconductor device 120. When the difference occurs in the amounts of thermal expansion between the contactor 111 and the semiconductor device 120, relative displacement occurs between the bumps 121 provided on the semiconductor device 120 and the contact portions 112A provided on the contactor 111, respectively.

25 However, as a result of the semiconductor testing device 110J having the above-described arrangement, directions of the relative displacement occurring between the bumps 121 and the contact portions 112A are the directions in which respective 30 line segments X extend, that is, radial directions. Therefore, even if the relative displacement occurs between the bumps 121 and contact portions 112A, it is possible to keep the contact pressures developed 35 between the bumps 121 and the contact portions 112A, respectively, constant. This is because, in this case, the directions of the relative displacement occurring between the bumps 121 and the contact portions 112A,

1 r spectiv ly, are the dir ctions along the widths of  
the contact portions 112A. As a result, the contact  
pressures developed between the bumps 121 and the  
contact portions 112A, respectively, do not change,  
5 even when the relative displacement occurs. Therefore,  
the above-described arrangement in which the direction  
in which each contact portion 112A extends, that is,  
the direction in which the extending end 125 of the  
contact portion 112A faces, is the direction indicated  
10 by the arrow Y, shown in FIG. 52, enables stable  
electrical connection to be maintained.

Further, it is also possible that the  
direction in which each contact portion 112A extends,  
that is, the direction in which the extending end 125  
15 of the contact portion 112A faces, is the direction in  
which the line segment X, shown in FIG. 52, extends.  
In this case, it is possible to prevent the bumps 121  
from separating from the contact portions 112A,  
respectively. This is because, in this case, the  
20 directions of the relative displacement occurring  
between the bumps 121 and the contact portions 112A are  
the directions indicated by the arrows Y1 and Y2, shown  
in FIG. 27B. Because the directions indicated by the  
arrows Y1 and Y2, shown in FIG. 27B, are the  
25 longitudinal directions of the contact portion 112A,  
the bump 121 is not likely to separate from the contact  
portion 112A, even when the relative displacement  
occurs. Therefore, the above-described arrangement in  
which the direction in which each contact portion 112A  
30 extends, that is, the direction in which the extending  
end 125 of the contact portion 112A faces, is the  
direction in which the line segment X, shown in FIG.  
52, extends enables stable electrical connection to be  
maintained.

35 Thus, the direction in which the contact  
portion extends may be set based on the directions of  
relative displacement occurring between the respective

1 one of the spherical connection terminals (bumps) and  
the contact portion due to a difference in thermal  
expansion between the contactor and the semiconductor  
device. Thereby, it is possible to set the direction  
5 in which the contact portion extends so that the  
contact pressure developed between the spherical  
connection terminal and the contact portion is  
prevented from changing due to the relative  
displacement. Specifically, the direction in which the  
10 contact portion extends is set to a direction which is  
perpendicular to the directions of the relative  
displacement. As a result, the contact pressure  
developed between the spherical connection terminal and  
the contact portion can be prevented from changing,  
15 and, thus, stable connection can be maintained.  
Alternatively, it is also possible to set the direction  
in which the contact portion extends so that the  
spherical connection terminal is prevented from  
separating from the contact portion due to the relative  
20 displacement. Specifically, the direction in which the  
contact portion extends is set to a direction  
corresponding to the directions of the relative  
displacement. As a result, the spherical connection  
terminal can be prevented from separating from the  
25 contact portion, and, thus, a stable connection can be  
maintained.

The thirty-third embodiment of the present  
invention will now be described.

FIGS. 53A and 53B show a semiconductor  
30 testing device 110K in the thirty-third embodiment of  
the present invention. In this embodiment, a single  
layer of wiring substrate 115B is used, and a contact  
portion 112R is previously connected with the internal  
connection terminal 117.

35 As mentioned above, recently, the  
semiconductor device 120 operates at high speed. In  
response thereto, signals used in testing of the

1 semiconductor device 120 flow at high speed. Thus, it  
is important to protect the testing from entrance of  
disturbance. For this purpose, there is a case where a  
partial circuit of a semiconductor tester used in  
5 testing of the semiconductor device 120 is provided on  
the semiconductor testing device 110K. Electronic  
components 138, shown in FIGS. 53A, 53B, include the  
partial circuit of the semiconductor tester.

As locations at which the electronic  
10 components 138 are provided, the contactor 111 or the  
wiring substrate 115B may be considered. However, it  
is very difficult to provide the electronic components  
138 on the contactor 111 which is a membrane substrate,  
and, also, the cost required therefor is high.  
15 Further, when the electronic components 138 are  
provided on the contactor 111, it is necessary to  
provide electronic wires for the electronic components  
138 on the insulating substrate 113 other than the  
contact portion 112R. Thereby, a problem occurs, that  
20 is, it is not possible to achieve a high-density  
arrangement.

Therefore, in this embodiment, the electronic  
components 138 are provided on the wiring substrate  
115B. Further, in order to achieve high-speed  
25 transmission of a test signal and to prevent entrance  
of disturbance, it is necessary to reduce the wiring  
length of the interposer between the internal  
connection terminal 117 and the external connection  
terminal 118 as much as possible. For this purpose, in  
30 this embodiment, the single-layer substrate is used as  
the wiring substrate 115B so that the wiring length is  
reduced. Electrical connection between the internal  
connection terminal 117 and the external connection  
terminal 118 is provided by using a through-hole  
35 conductor 136 formed in an insulating layer 116.

As a result of the contact portion 112R being  
previously connected with the internal connection

1 terminal 117, the contact portion 112R is not bent each  
time the bump 121 is inserted into the opening 114.  
Thereby, brittle fracture of the contact portion 112R,  
at the position at which the contact portion 112R is in  
5 contact with the periphery of the opening 114, can be  
prevented. As a result, it is possible to elongate the  
life of the contactor 111.

The spherical connection terminal of the  
semiconductor device is not limited to the bump made of  
10 solder. It is also possible that, in the semiconductor  
device, for which the present invention can be used,  
another material (gold, copper, or the like, for  
example) is used as the material of the spherical  
connection terminal. Further, it is also possible  
15 that, in the semiconductor device, for which the  
present invention can be used, a connection terminal  
other than the spherical connection terminal (a stud-  
shaped bump, for example) can be used, alternatively.

Further, the wiring substrate is not limited  
20 to a substrate made of a resin such as glass epoxy. It  
is also possible to use a substrate made of another  
material, such as a ceramic substrate or the like.

Further, the present invention is not limited  
to the above-described embodiments, and variations and  
25 modifications may be made without departing from the  
scope of the present invention.

The contents of the basic Japanese Patent  
Application Nos. 9-255786 and 10-263579, filed on  
September 19, 1997 and September 17, 1998,  
30 respectively, are hereby incorporated by reference.